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Better Homes and Gardens®

WOOD®

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p.40

simple patterns and jigs guarantee your success!

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FOR THE HANDYMAN

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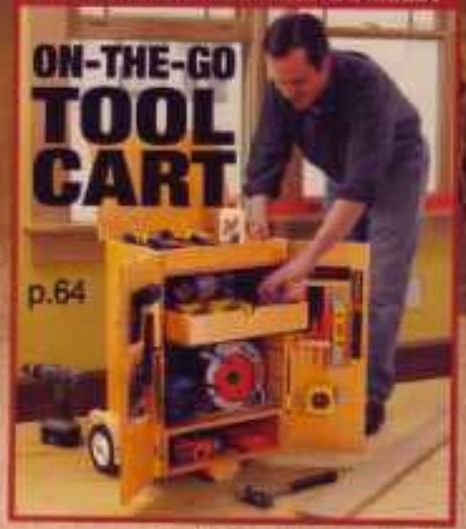

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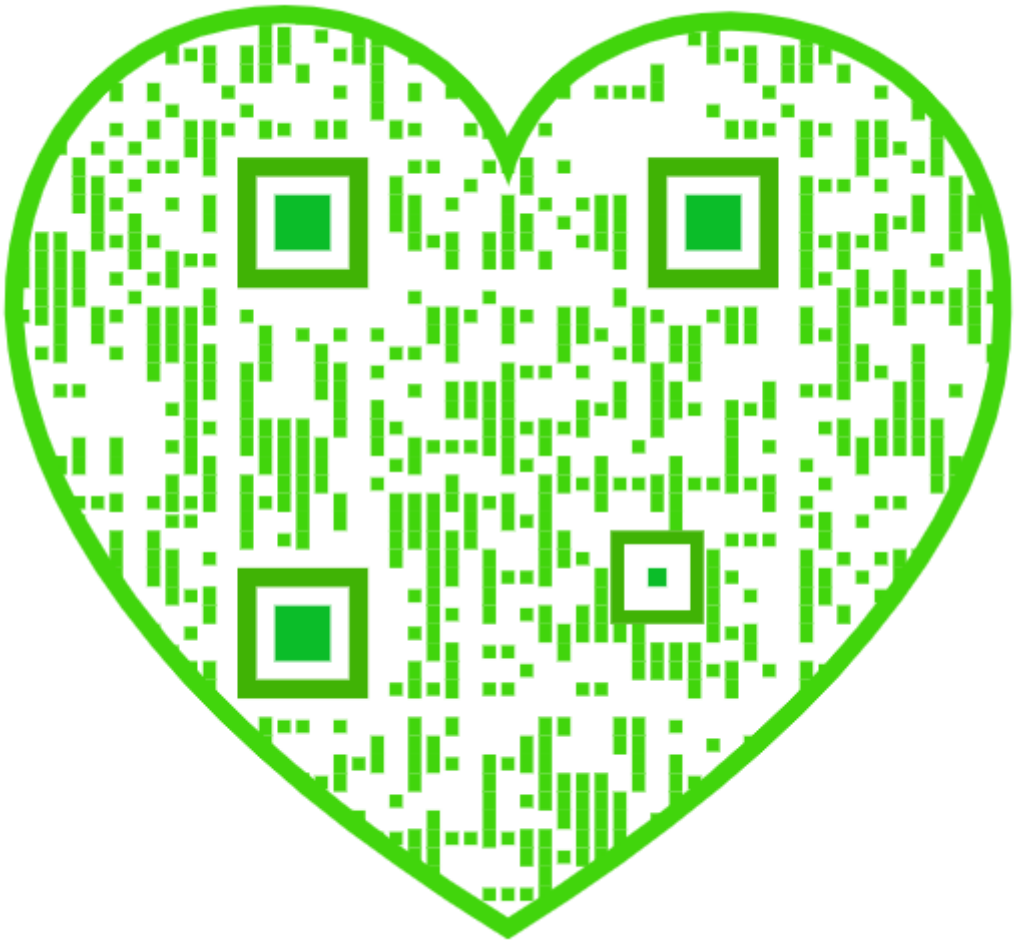

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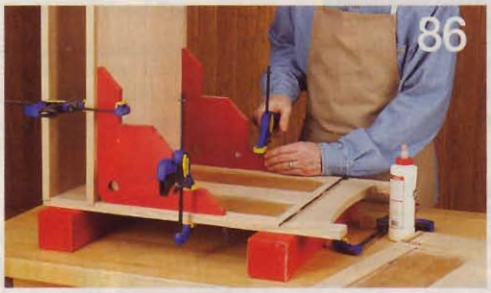

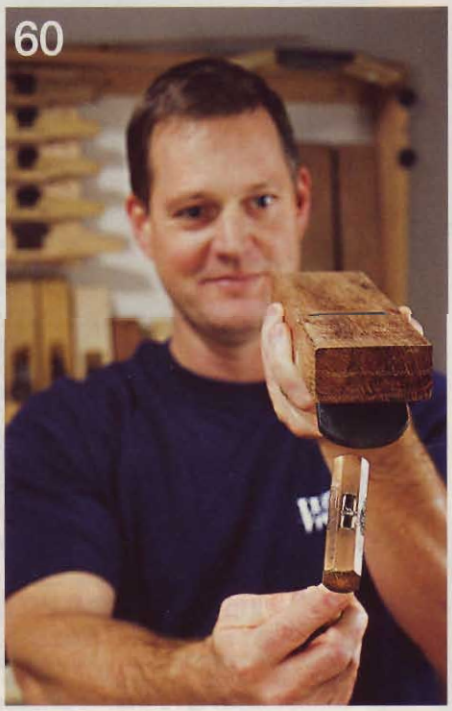

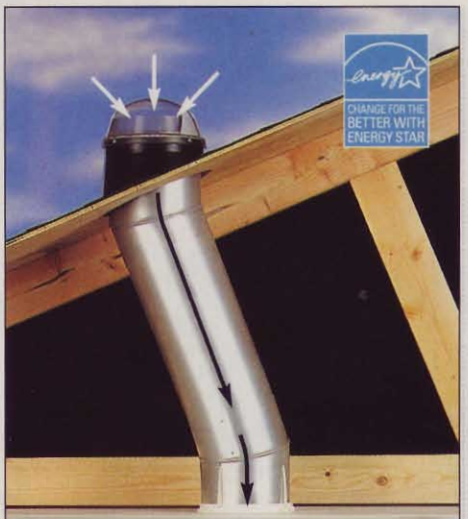

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In Memoriam — E.T. Meredith III (1933–2003)

Owen built this mission end table out of quartersawn white oak.

Jim, daughter Kelly, and granddaughter Ellie, with the changing table he designed and built.

Pat with the plate rack/shelf unit she made at woodworking class.

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editor's angle

Does your shop belong in rehab?

Mine does. Over time it's become cluttered and covered in dust. And although I always manage to somehow get my projects built, I know my shop needs reorganizing. If your shop needs a little help, too, you'll enjoy the new "Workshop Workover" feature in this issue.

From left, Techniques Editor Dave Stone, reader Jerry Mertens, and Senior Design Editor Kevin Boyle in Jerry's worked-over workshop.

How much more efficient would you be in your workshop if you never had to hunt for a sharp pencil, track down a tape measure, or scrounge up a missing fastener? What if you could simply mosey from one end of your shop to the other without stepping over and around obstacles? Would you enjoy your shop time even more? We're betting you would, and that's why we're introducing our new series "Workshop Workover" on *page 76* to help you get organized.

We approached this article quite differently than our five Idea Shops from the past 12 years. In those we built a shiny new workshop from scratch and packed it full of projects and ideas you could adapt to your shop. A big undertaking, for sure, but one that proved worth it because of how much readers embraced the results.

But after completing Idea Shop 5 one year ago we wondered if we could take the shop-improvement concept and make it even more practical and affordable for you. After a lot of discussion, we decided to take on the rehabbing of a reader's workshop. So in the October issue we asked you to submit your shops for consideration. Not surprisingly, a flood of submissions (397 in total) ensued.

From those, we selected Jerry Mertens' shop in Forsyth, Missouri. His space was pretty much what we were looking for: not a complete disaster, but a working shop in big-time need of better efficiency, storage, and organization. Tools and supplies were hard to find among fishing gear and trophies. Sound familiar?

And that's when Senior Design Editor Kevin Boyle and Techniques Editor Dave Stone swung into action. Armed with photos and floor layouts of Jerry's shop, they brainstormed ways to better it.

Now, it would have been easy to simply throw money and new tools at Jerry's shop. That wouldn't be especially helpful to most of you, so I gave Kevin and Dave two restrictions: they were to spend no more than $1,000 on materials and be in Jerry's shop for only two days.

What they did within those limitations was remarkable, proving that you don't have to invest a ton of time or money to drastically improve your shop.

And what did Jerry think of the entire experience? He was thrilled as you can tell in the photo *above*. Not only was his shop made fully functional, but Kevin and Dave even found spots for his fishing stuff.

Bill Krier

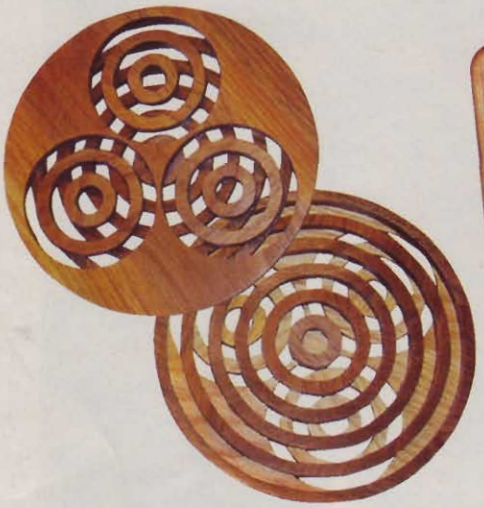
sounding board

Our bulletin board for letters, comments, and timely updates

No lathe? No problem. Readers prove creative.

I liked the design of your "Trivet Pursuit" project (issue 154, page 70), but I don't have a lathe. So I made mine, *below*, by scrollsawing the individual rings and gluing the trivet halves together using the full-size patterns as guides.

Charlie Gilfoyle, Tacoma, Wash.

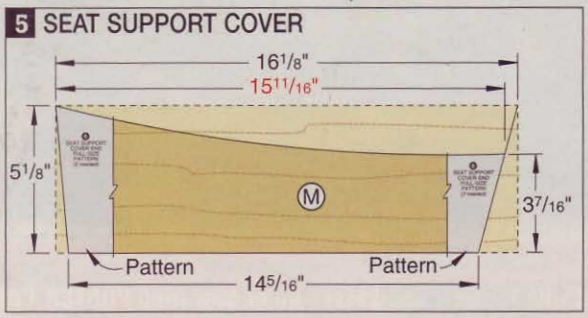


Your "Trivet Pursuit" trivets really intrigued me, but since I don't have a lathe, I thought I wouldn't be able to build them. Then I decided to give the project a try using my new circle-cutting jig for my router. After gluing up maple and cherry blanks (I made mine square), I used the patterns to lay out pivot-pin holes, then routed each circle. Finally, I enlarged the pivot-pin holes using a ½" Forstner bit.

John L. Haase, Whiting, N.J.

Project Update

Adirondack Glider (issue 155, page 34): The seat support covers (M) should be 15 11/16" long. To lay out the end angles on these pieces, as shown in **Drawing 5** on page 37, adhere the full-size patterns to your workpiece where shown, *right*.



Teacher counts the ways shop classes help students

As an industrial arts/technology education teacher for 32 years, I especially appreciated your inspirational stories of teachers and students working together to keep high school shop programs open. (See "Workshop Revival," issue 155, page 84.)

Too often, these programs face budget cuts because they're not seen as critical for "getting our kids ready for college." On the contrary, I believe woodworking programs teach many valuable skills. Here are just a few:

- **Math skills.** Woodworking requires kids to calculate fractions, lay out parts, figure angles, and estimate material needs. All of these tasks demonstrate practical real-world ways to apply abstract math concepts.
- **Goal setting.** Building projects shows kids how to set a target then work toward it. And they get concrete reinforcement of their goals as they create parts and bring the project together.
- **Motor skills.** Using woodworking tools helps kids develop coordination and skills they'll need to operate other machinery—from computers to cars.
- **Teamwork.** Group activities bring students together to accomplish tasks.
- **Community involvement.** Students can learn the value of getting involved by taking on projects to improve their school and community.
- **Science.** In order to successfully work with wood, kids need to understand its characteristics.

John Sokolovich, New Oxford, Pa.

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- **Updates to previously published projects:** For an up-to-date listing of changes in dimensions and buying-guide sources from issue 1 through today, go to woodmagazine.com/editorial.

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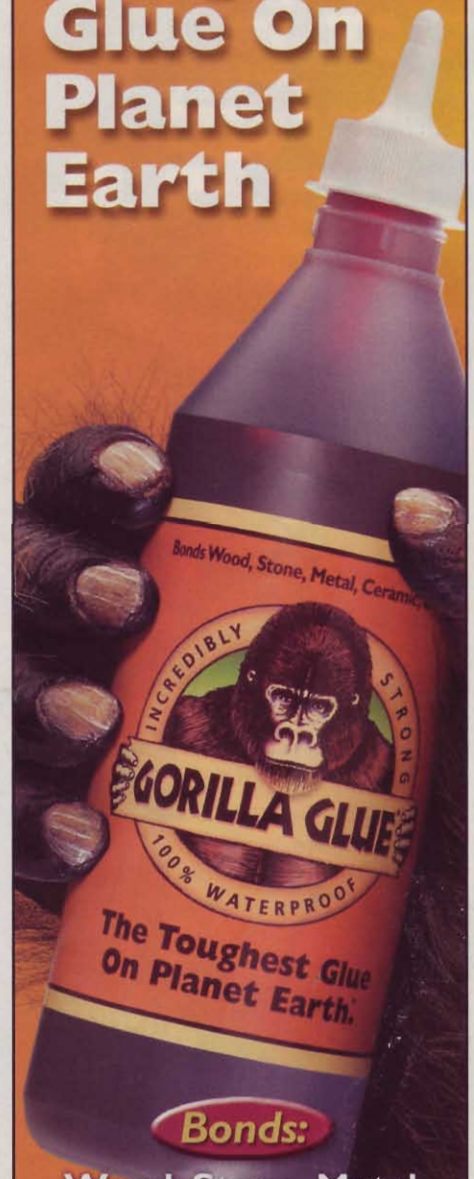

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pin pointers

A router table starter pin puts you in control of your work for smoother results.

With the workpiece against the pin, ease the starting point edge into the center of the bit's bearings. Maintain even pressure now on both the pin and the bit as you begin routing the edge.

Functioning much like a fulcrum, this router table accessory is as valuable as it is simple. Used in combination with bearing-piloted router bits, a starter pin lets you brace your workpiece for more precise and controlled freehand edgework.

You can buy metal and plastic starter pins, such as a brass version from Eagle America ($4.99; eagle-america.com), but it's easy to make one from a dowel or a piece of steel rod. Pins should snugly fit the starter pin hole in the router table and need only reach about an inch above the table surface.

Starter pins are best mounted less than 2" from the outside edge of your bit. If you're using a homemade router table that's not predrilled for a starter pin, drill the pin hole slightly in front and to the right of the bit on the infeed side.

Brace yourself

Start your router and brace the workpiece against the pin. Pivot the starting corner of it firmly and smoothly toward the cutter. Keep your work pressed against the starter pin as the edge of your workpiece comes to rest against the bit's bearing, as shown *above*. Ease your workpiece away from the starter pin as the bearing takes over, feeding the raw edge into the bit in a counterclockwise motion, as shown *below*.

Instantly, you'll notice that a starting pin gives you added control of your workpiece during the critical point when the stock first touches the spinning bit. For safety's sake, use a push pad for small workpieces.

Photographs: **Scott Little**

Once your workpiece is firmly in contact with the roller bearing, ease away from the pin for greater freedom of movement.

perfect-score marking gauge

With both single and paired marking points, this great-looking hand tool helps you lay out rabbets, tenons, and mortises with hairline precision.

WOOD MAGAZINE COLLECTOR'S SERIES HAND TOOLS

Woodworkers have been using sharp instruments to make layout lines on wood for centuries. In fact, the first marking and mortising gauges predate the development of mass-produced pencils. Even with the availability of pencils, craftsmen still scribe the most accurate layout lines on wood with the sharp points of a gauge. Now you can make your own version and experience the difference firsthand.

Laminate the body

1 To form the body (A), cut two ⅜×2⅝×4¼" faces (we used bubinga) and one ¼×2⅝×4¼" core (we used maple). Apply glue, and laminate the faces and core in the order shown on **Drawing 1**, keeping the ends and edges flush. With the glue dry, trim one edge of this blank flush on your tablesaw, and then flip the piece and trim the other edge, leaving a 2½"-wide blank. Then, trimming both ends, cut the blank to 4" in length.

2 Make a copy of the full-size body pattern on the *opposite page*, and adhere it to the blank with spray adhesive. Transfer the ⅜" hole centerline on the pattern to the top edge of the blank, and drill a 1⅛"-deep hole for a threaded insert, as shown in **Photo A**.

3 Chuck a ½" Forstner bit in your drill press, and position the fence to align the bit with the holes, shown on the pattern, that form the ends of the slot in the body (A). Drill the end holes, and then drill through the center to remove most of the material from the slot. Clean up the slot with a chisel.

4 Bandsaw and sand the body (A) to shape. Then rout ⅛" round-overs along its edges, where shown on the pattern and **Drawing 1**.

DRILL A HOLE FOR THE INSERT

Adhering a masking tape "flag" to a ⅜" Forstner bit to mark the depth, drill a 1⅛"-deep hole centered in the body (A).

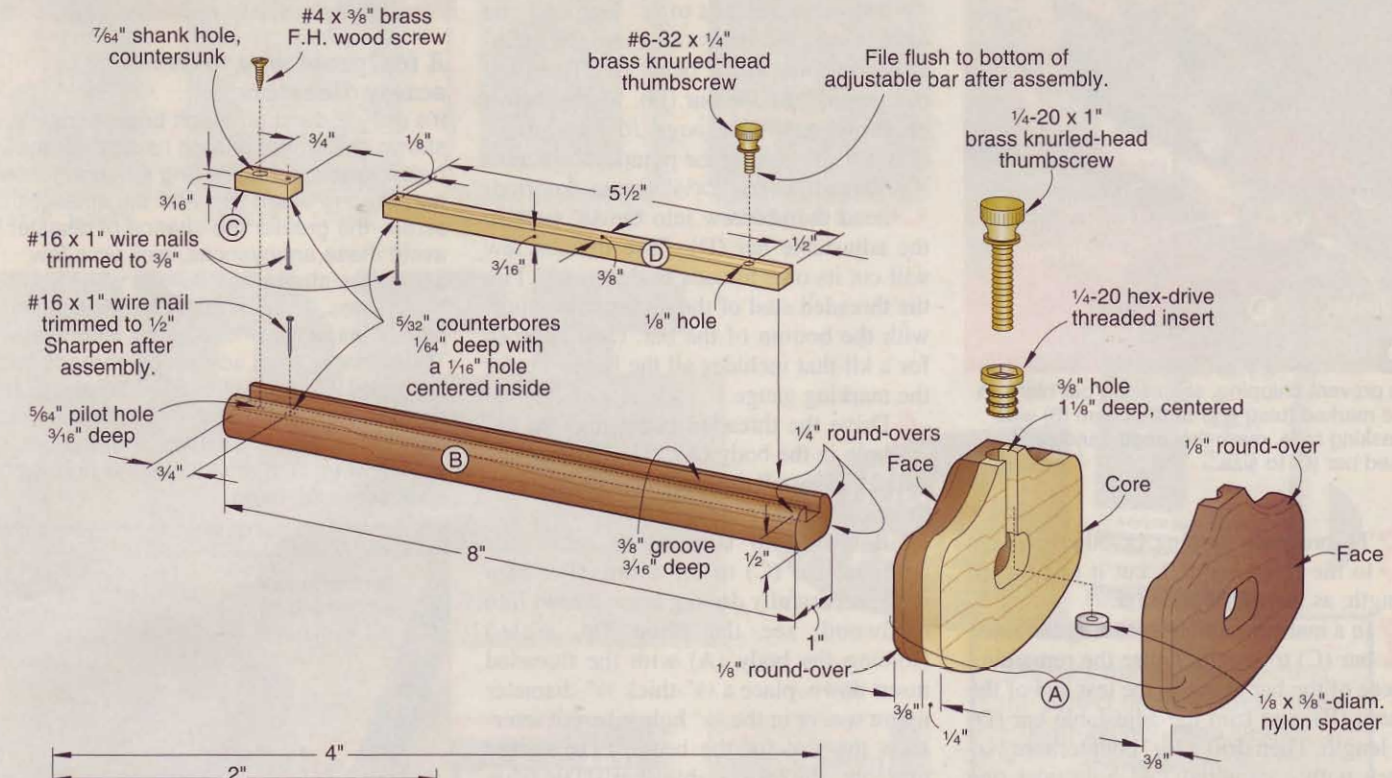
Add a beam and bar

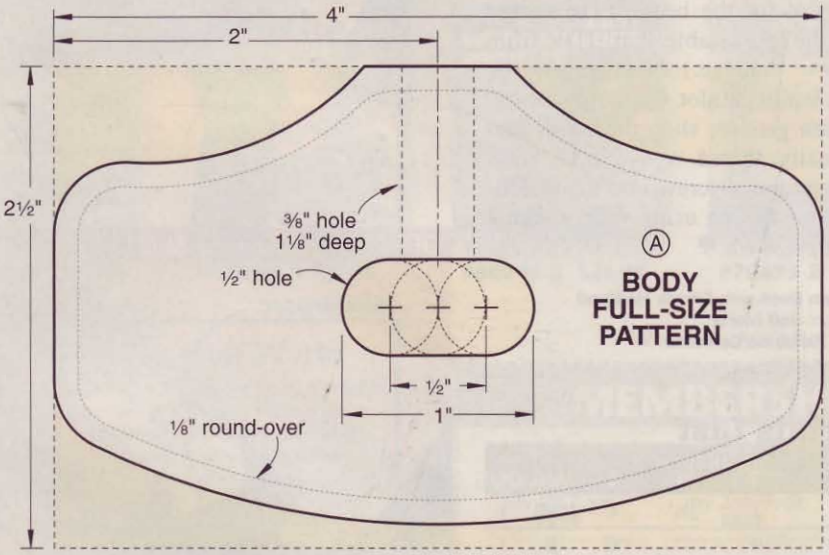
1 Cut the beam (B) to thickness and width but about 4" longer than the length listed in the **Materials List**. (The extra length will be used to test the fit of the beam in the body slot.) Then cut a groove for the bars (C, D) in one beam face, where shown on **Drawing 1** and as shown in **Photo B**.

2 Chuck a ¼" round-over bit in your table-mounted router, and rout 1"-long round-overs on all four edges of the beam (B). Test-fit the routed end of the beam in the body (A) slot, as shown in **Photo C**. Make any adjustments needed for a good fit. Mark the test end of the beam, and rout its entire length. Do not cut the beam to finished length.

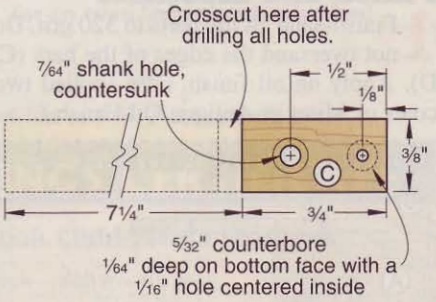
3 In the *unmarked* end of the beam, use a 5/32" brad-point bit to drill a 1/64"-deep counterbore centered in the beam groove, where shown on **Drawing 1**. (The counterbore must be deep enough to recess the head of a #16 wire nail slightly below the bottom surface of the groove.) Then drill a 1/16" hole centered in the counterbore.

1 EXPLODED VIEW





2 FIXED BAR (top face shown)



4 Resaw and plane a 3/16×3/8×8" blank for the fixed bar (C) and adjustable bar (D), testing it for a snug but moveable fit in the beam (B) groove.

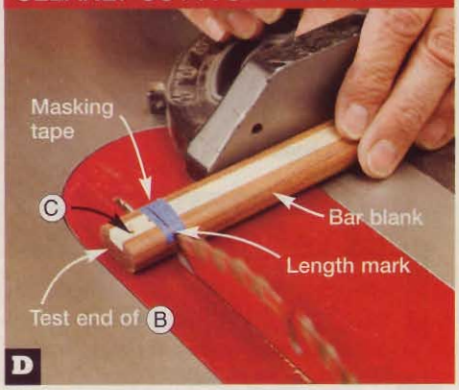
5 To make the fixed bar (C), drill a 7/64" countersunk shank hole in one end of the bar blank, where shown on **Drawing 2**. Then on the face opposite the countersink, use a pilot-point bit to drill a 5/32" counterbore 1/64" deep, where shown. Centering a 1/16" bit in the counterbore, drill a hole. Place the bar blank countersunk face up in the beam (B) groove with the holes in the beam and bar at the same end. Align the bar and beam ends, and using the countersunk shank hole in the bar as a guide, drill a 5/64" pilot hole 3/16" deep into the beam.

TWO KEY STEPS IN MAKING THE BEAM

Install a zero-clearance insert in your tablesaw, and cut a 3/8" groove 3/16" deep centered in one face of the beam (B).

With 1" of the edges of one end of the beam (B) rounded over, test-fit it in the body (A). The fit should be snug yet moveable.

CLEANLY CUT A SMALL PART



To prevent chipping, secure the bar blank in the marked (test) end of the beam (B) with masking tape, mark the length, and cut the fixed bar (C) to size.

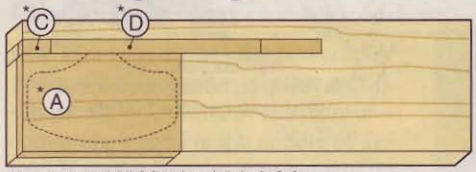
6 To prevent chipping or other damage to the fixed bar (C), cut it to finished length, as shown in **Photo D**.

7 In a manner similar to cutting the fixed bar (C) to length, house the remaining piece of the bar blank in the test end of the beam (B), and trim the adjustable bar (D) to length. Then drill a 5/32" counterbore 1/64" deep with a centered 1/16" hole near one end of the bar and a 1/8" hole near the other end, where shown on **Drawing 1**. Trimming off the test end, cut the beam to finished length.

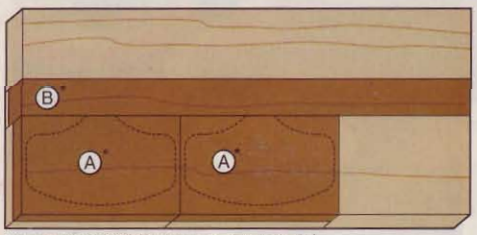
Finish and assemble

1 Finish-sand all the parts to 320 grit. Do not oversand the edges of the bars (C, D). Apply an oil finish. (We applied two coats of Minwax Antique Oil Finish.)

Cutting Diagram



¾ x 3½ x 12" Maple (.3 bd. ft.)
*Plane or resaw to the thicknesses listed in the Materials List.



¾ x 5½ x 12" Bubinga (.5 bd. ft.)

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2 For the marking points, snip two #16×1" wire nails to 3/8" long and one to ½" long, and press them into the counterbored holes in the beam (B), fixed bar (C), and adjustable bar (D), where shown on **Drawing 1**. (See *page 16* for instructions on sharpening the points.)

3 Thread a #6-32×¼" brass knurled-head thumbscrew into the 1/8" hole in the adjustable bar (D). (The thumbscrew will cut its own threads in the wood.) File the threaded stud of the thumbscrew flush with the bottom of the bar. (See **Sources** for a kit that includes all the hardware for the marking gauge.)

4 Drive the threaded insert into the 3/8" hole in the body (A). (Use a 6mm hex wrench to install the insert that comes with the kit.)

5 Referring to **Drawing 1**, screw the fixed bar (C) to the beam. (For help with successfully driving brass screws into hardwood, see the **Shop Tip**, *right*.) Holding the body (A) with the threaded insert down, place a 1/8"-thick 3/8"-diameter nylon spacer in the 3/8" hole where it intersects the slot for the beam. (The spacer protects the adjustable bar (D) from thumbscrew damage.) Next insert the adjustable bar in the slot. Capturing the bar in the beam groove, slide the beam into place. Finally thread a ¼-20×1" brass knurled-head thumbscrew into the threaded insert. For tips on using your marking gauge, see *page 16*.

Written by **Jan Svec** with **Chuck Hedlund**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine**

Materials List

Part	FINISHED SIZE T	W	L	Matl.	Qty.
A* body	1"	2⅜"	4"	LMB	1
B* beam	½"	1"	8"	B	1
C* fixed bar	3/16"	3/8"	¾"	M	1
D* adjustable bar	3/16"	3/8"	5½"	M	1

*Parts initially cut oversize. See the instructions.

Materials key: LMB–laminated maple and bubinga, B–bubinga, M–maple.

Supplies: Spray adhesive.

Blades and bits: 3/8" and ½" Forstner bits, stack dado set, 1/8" and ¼" round-over router bits.

Sources

Hardware kit. #16×1" wire nails (3), #4×3/8" brass flat-head wood screw (1), #6-32×¼" and ¼-20×1" brass knurled-head thumbscrews (1 ea.), ¼-20 hex-drive threaded insert (1), 1/8×3/8"-diameter nylon spacer (1). Kit no. MG-2, $4.95 ppd. Add $3.50 for each additional kit. Schlabaugh and Sons Woodworking. Call 800/346-9663, or go to schsons.com.

Wood and hardware kit. The hardware listed *above* plus wood of the required thickness to make one gauge. Kit no. MG-2W, $10.95 ppd. Add $9.50 for each additional kit. Schlabaugh and Sons Woodworking, see *above*.

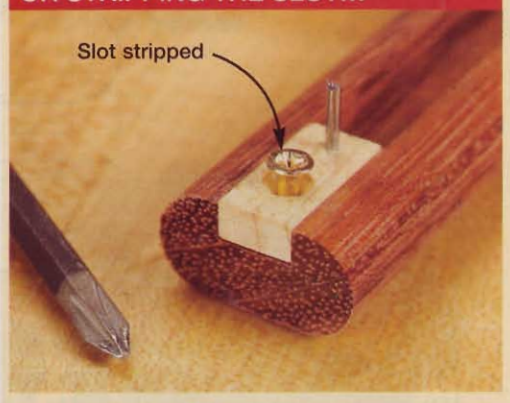
SHOP TIP

A foolproof way to avoid screw disasters

It's easy to twist off a soft brass screw, as shown *below top*, or strip its slot, as shown *below center*, when driving it into a hardwood part like the beam (B). And the smaller the screw, the greater the chance of disaster. To avoid these annoyances, pick up a few same-size steel wood screws when you buy brass ones. Then, after drilling shank and pilot holes, drive in one of the steel screws. The stronger steel screw cuts threads into the wood with less chance of breaking. Now remove the steel screw and drive the brass one. Store the steel screws with the brass ones and you'll always have the right size steel screw on hand.

AVOID BREAKING A BRASS SCREW...

OR STRIPPING THE SLOT...



BY FIRST DRIVING A STEEL SCREW.

how to put a marking/mortising gauge to work

Whether it's the Collector's Edition marking/mortising gauge on *page 12*, or a commercially made one, here's how to make good use of this traditional layout tool.

Use the single point to scribe the shoulders of a tenon...

When you want a fast and accurate way to lay out guidelines for cutting joints, reach for a marking/mortising gauge. The three photos, *right*, show typical applications for a marking gauge.

Available in variations from ordinary to ornate, all marking gauges work the same way. A beam holding a single sharp marking point (marking gauge), a pair of points (mortising gauge), or both single and paired points (combination gauge) slides through the body. The body has a device for locking the beam in place, fixing the point or points a set distance from the body.

Why use a gauge instead of a pencil? The line created by a wood pencil changes thickness along its length as the pencil point dulls. The point on a gauge scribes a much thinner and consistent line, eliminating "thickness of line" errors. It also provides an accurately placed groove for the tip of your chisel. The main disadvantage of scribed layout lines is that you can't erase them, although in most cases, the lines are eliminated or covered up when cutting or assembling the joint.

Sharp points cut fine lines

To scribe narrow, consistent lines, you need sharp points. Most commercial gauges have conical, nail-like points, which scratch the surface instead of cutting it. These points leave fuzzy lines when marking across the grain and are likely to follow the grain when marking parallel to it. For best results, file the points to form a two-sided knife edge, as shown *below, left*. Make sure the point edge is parallel to the gauge body. Sharpen paired points to the same length.

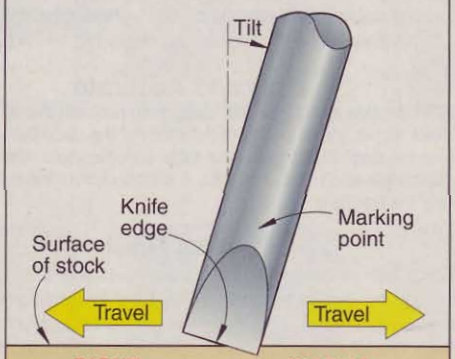
Continued on page 19

... or scribe plywood to prevent chipping when cutting rabbets.

FILE THE POINT FOR TOP-NOTCH RESULTS

Remove the beam from the body, and clamp it to your workbench. Protect the beam with a couple layers of masking tape, and use a fine flat file to form a two-sided knife point.

HOW POINT ORIENTATION AFFECTS LINE QUALITY

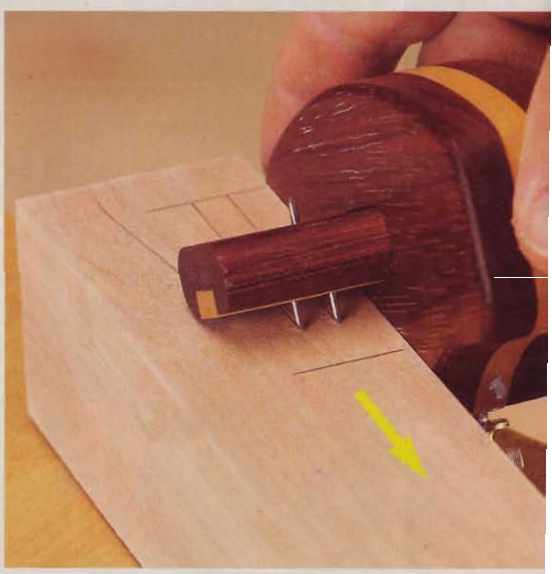


RIGHT

Tilting the marking point away from the direction of travel presents its knife edge to the stock. The point cuts a clean line.

WRONG

Tilting the marking point toward the direction of travel presents its blunt side to the stock. The point scratches a fuzzy line.

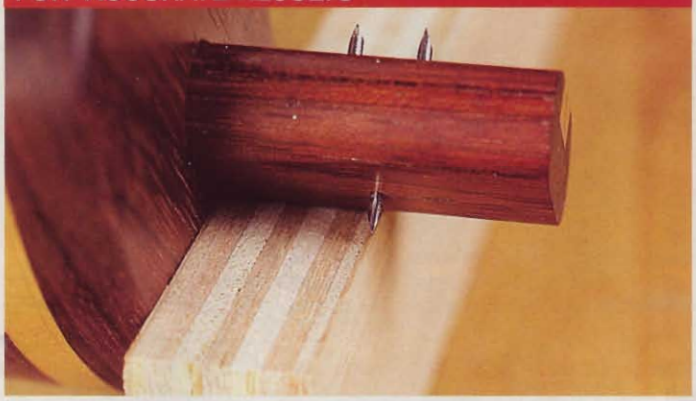


Set the paired points to the width of a tenon, and scribe mortises on your stock.

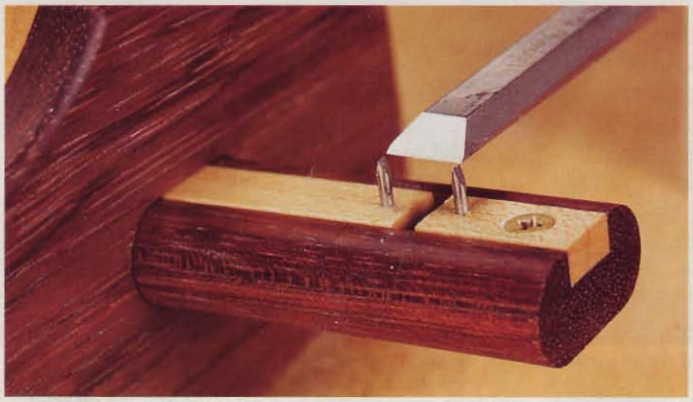
Engaging the gauge

To use a marking gauge, set the point the desired distance from the body using a steel ruler or the actual stock that will fit the joint, as shown *below top*, and lock the beam in place by tightening the knurled-head thumbscrew. To set the distance between the twin points of a mortising gauge, use the bit or tool you'll use to cut the mortise, as shown *below center* and *bottom*. Then hold the body tightly against the edge of the workpiece, tilt the gauge slightly away from you to present the cutting edge of the point or points to the wood, as shown in the drawing on *page 16*, and pull the gauge toward you. Use this method to scribe lines parallel to the grain, across the grain, or on end grain.

3 WAYS TO POSITION GAUGE POINTS FOR ACCURATE RESULTS



Position the points with the stock...



...or the tool...

...or the bit you'll use.

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blade and bit cleaners

Which ones work best?

If cleaning your saw blades and router bits sits near the bottom of your "to-do" list, you may be shortening the life of your carbide cutters. We tested eight products and several home remedies to see which work fastest and safest.

After soaking one set of teeth for five minutes (5M) in CMT 2050, most of the buildup wiped away easily. Note the dark deposits left in the soaking cup from the action of the cleaner alone. The "control" section shows the condition of the uncleaned teeth.

The crud that inevitably builds up behind the carbide teeth and cutters on your saw blade and router bits is more than just an unwelcome nuisance. It affects the quality of your work by requiring more feed pressure to make the cut and burning the edges. In fact, cutters and blades with excessive buildup are sometimes mistaken for dull. A thorough cleaning often can rejuvenate a cutter's performance faster (and cheaper) than sending it to the sharpening shop.

Keeping your cutters clean has another less obvious benefit. Left unchecked, resins and pitch from wood and adhesives from man-made products (such as plywood and MDF) can corrode the blade or router-bit body and deteriorate the carbide. Such deterioration hastens dulling.

Job one: Making the mess

To ensure that all cleaners in our test had to deal with the same quality and quantity of gunk, we got ahold of new Freud LU74M 80-tooth crosscut blades, installed each one *backward* on a tablesaw (to speed the gunking-up process), and then ripped equal lengths of pressure treated pine. To see how a factory-applied nonstick coating might affect the performance of the cleaners, we repeated the filthing on Freud LU74R blades (the nonstick-coated version of the LU74M). Next, we marked each blade into 6-tooth sections that fit easily into shallow cups filled with a cleaner, as shown in the photo, *top*.

For each cleaner, we soaked one set of teeth for five minutes, and then gently wiped the teeth with a clean rag and noted how much buildup was left behind. If the cleaner removed all of the filth, we graded it with an "A" and stopped testing. If any residue remained, we soaked the next section for 30 minutes, wiped, and graded again. If needed, we then soaked the next group of teeth for 5 hours, wiped and graded. The grades for all three soaking times are shown in the chart on *page 22*.

Consider safety *and* speed

Take a look at the Safety column on the chart, and you'll see that these cleaners and home remedies run the gamut from mild to dangerous. Pay special attention to those that are flammable and/or corrosive: Those products can cause bigger problems than a dirty blade if mishandled or misused. Even if a product label doesn't specifically instruct you to do so, protect your hands and eyes.

The fumes from some products, such as oven cleaner and Sprayway Saw Cleaner, are strong enough to catch in the back of your throat. With these products, wear a respirator and work in a well-ventilated area.

After cleaning your blades and bits, inspect the cutting edges for cracks or chipping, and discard any cutter showing such damage. When in doubt, toss it out.

Continued on page 22

Bear these tips in mind for piloted bits

Blade and bit cleaners can rob router-bit bearings of their lubrication, which leads to premature bearing failure. Before cleaning the bit, spin the bearing by hand to ensure it turns freely. If it spins easily, remove it and set it aside; otherwise discard it and get a replacement. When the bit is clean, reinstall the bearing and treat it with a high-speed router-bearing lubricant, as shown at *right*.

Finally, protect them with a coating of a rust-preventative product, such as those reviewed in *WOOD*® magazine, issue 154. Boeshield T-9 (boeshield.com, 800/962-1732) earned top honors in that test.

5 lessons learned

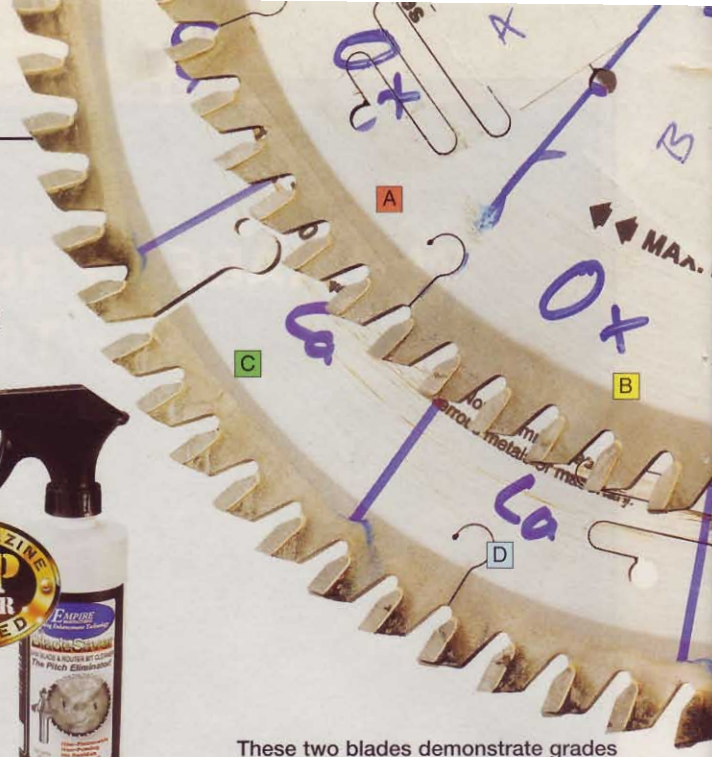
Lesson #1: Except for oven cleaner, none of the home remedies worked as well as the specialty products formulated specifically for cleaning blades and bits. (We've heard kerosene suggested as a blade cleaner, but in our tests, it had no effect at all, so we left it out of the chart.)

Lesson #2: If you're not in a big hurry, all of the specialty products cleaned very well with a five-hour soaking.

Lesson #3: On nonstick-coated blades, all of the specialty products cleaned well enough after five minutes to put the blades or bits back to work. For this luxury, you'll pay only $5–$10 more per blade than uncoated blades. Money well spent, in our opinion.

Lesson #4: Two cleaners removed all of the gunk after only five minutes on uncoated blades—Sprayway Saw Cleaner and Empire BladeSaver. When you factor in product safety, we have to go with BladeSaver, which is virtually harmless and can be rinsed or dumped down the drain without danger of polluting.

Lesson #5: In a pinch, oven cleaner will do the trick, but use it with caution and plenty of ventilation. Know, too, that blade makers caution that it may damage your blade.



These two blades demonstrate grades A through D on the chart. An F grade indicates that the cleaner had no apparent effect on the blade grime.

CUTTING THROUGH THE CRUD: PERFORMANCE GRADES FOR BLADE AND BIT CLEANERS

CLEANER	MANUFACTURER'S SUGGESTED APPLICATION METHOD	CLEANING EFFECTIVENESS AFTER SOAKING (1) — UNCOATED BLADE: 5 MINUTES	UNCOATED BLADE: 30 MINUTES	UNCOATED BLADE: 5 HOURS	NON-STICK COATED BLADE: 5 MINUTES	NON-STICK COATED BLADE: 30 MINUTES	NON-STICK COATED BLADE: 5 HOURS	SAFETY	ESTIMATED COST PER TREATMENT (2)	PRICE (3)	FOR MORE INFORMATION:
SPECIALTY PRODUCTS											
BOESHIELD BLADE AND BIT	Spray and let soak for 30–60 seconds. Wipe dry.	B	A-	A	A	*	*	Nonflammable. Eye and skin irritant. Gloves recommended.	.18	$9 for 8.5 oz.	800/962-1732 www.boeshield.com
CMT FORMULA 2050	Spray and allow to soak for a few minutes. Wipe with rag or sponge.	A-	A-	A	A	*	*	Biodegradable, non-toxic, and nonflammable. Mild eye irritant.	.48	$12 for 18 oz.	888/268-2487 www.cmtusa.com
EMPIRE BLADE SAVER	Wet blade and work with soft bristle brush, if neccesary. Rinse with water and air dry.	A	*	*	A	*	*	Water-based. Eye and skin protection recommended.	.08	$17 for 16 oz.	866/700-5823 www.empiremfg.com
LENOX WOOD PITCH CLEANER	Soak tools to remove pitch. Also can apply before cutting to prevent buildup.	B	B	A	A-	A	*	Nonflammable. Eye protection recommended.	.25	$3 for 8 oz.	800/642-0010 www.lenoxsaw.com
OXISOLV	Spray or soak for a few minutes, rinse with water, and wipe dry.	B	B	A	A-	A	*	Eye and mild skin irritant. Nonflammable. Low flammability.	.91	$10 for 20 oz.	800/594/9028 www.oxisolv.com
PITCH RX	Soak blade or bit in product for 2–3 minutes. Rinse with water and dry.	B	A-	A	A	*	*	Biodegradable, and nonflammable. Mild eye and skin irritant.	.27	$13 for 16 oz.	770/680-0006 www.aroundtheshopinc.com
SPRAYWAY SAW CLEANER	Spray and allow to stand for 5 minutes. Wipe with damp cloth, sponge, or paper towel.	A	*	*	A	*	*	Corrosive. Wear eye, skin, and lung protection.	.63	$5 for 18 oz.	800/332-9000 www.spraywayinc.com
WOODCRAFT RESIN REMOVER	Dilute with 4 parts water. Wipe on, brush on, or soak blade or bit in cleaner.	B-	B-	A	A-	A	*	Mild skin irritant. Wear eye protection when mixing.	.11	$10 for 16 oz. (makes 5 pints)	800/225-1153 www.woodcraft.com
OTHER COMMON CLEANERS											
CARBURETOR CLEANER		D	C	C-	C-	C	B	Dangerous fumes. Eye and skin irritant.			
CITRUS-BASED CLEANER		F	D	C-	D-	D	B	Organic and biodegradable. Slightly flammable.			
FORMULA 409		C-	C	B-	A-	A	*	Nonflammable. Eye and skin irritant.			
OVEN CLEANER		A	*	*	A-	A	*	Corrosive and flammable. Wear eye, skin, and lung protection.			
SIMPLE GREEN		C-	B	B	A-	A	*	Biodegradable, nontoxic, and nonflammable. Mild eye irritant.			

NOTES:
1. See photos for examples of grades. * No further testing needed.
2. Based on cleaning a 10" saw blade. Cost per treatment is affected by application method and cleaning efficiency.
3. Prices current at time of article's production and do not include shipping, where applicable.

short cuts

News and notes from the woodworking world

Projects with personality

If you're looking for a way to add life to your projects, consider the creations made by Straight Line Designs Incorported in Vancouver, B.C. Designer and founder Judson Beaumont began the company more than 13 years ago for the purpose of designing and building custom furniture with an original, often unconventional twist. Says Judson, "Most of our past projects have focused on 'children' and 'the family,' so our initial approach is to incorporate elements that make every one unintimidating, interactive, and fun!"

To see more of the company's imaginative designs, visit straightlinedesigns.com.

Photographs: Courtesy of Judson Beaumont

Big news: Black & Decker buys Pentair power tool group

The Black & Decker Corporation of Towson, Maryland, has moved to purchase the power tool group belonging to Minnesota-based Pentair Incorporated for $775 million. The sale includes companies that manufacture woodworking products, specifically: Delta (stationary power tools); Porter-Cable (benchtop and portable power tools); DeVilbiss Air Power (compressors); and Oldham Saw (saw blades). Says Nolan D. Archibald, B&D Chairman and CEO, "This acquisition will add well-respected brands to our portfolio and expand our offerings in product lines where we have relatively low market share." More later.

Continued on page 26

The fastest way to join wood just got more precise...

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Test your workshop smarts

Raise your woodworking IQ by trying the quick queries below. Find the answers in the next issue of *WOOD*® magazine's Short Cuts, or go right now to woodmagazine.com/shortcuts.

■ **What's the origin of "penny," the word used to define nail sizes?**

■ **What woods were used in the construction of Civil War-era canteens?**

■ **Can you name this obscure Victorian-era hand tool and describe its use?**

Answers to the questions in issue 157:

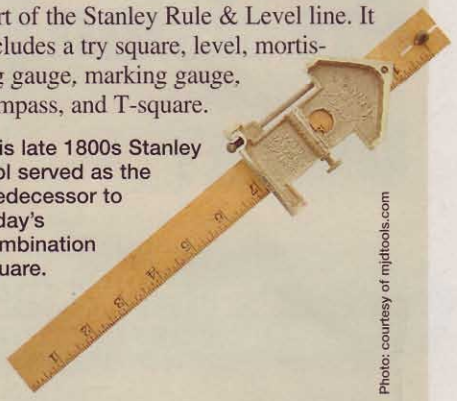
■ **True or false: Water rings on furniture surfaces are in the layer of furniture polish or wax above the finish.**
False. Water rings develop in the finish, says finishing expert Bob Flexner. Older shellac or lacquer finishes are most prone because of their porous nature.

Remove rings in old lacquer and shellac finishes by using the appropriate solvents.

To remove the ring in old shellac, Bob advises lightly dampening a rag in denatured alcohol and wiping the affected area. This causes the finish to redissolve, lose its porosity, and become "compacted." The result: a restored clear finish .

For old lacquer finishes, Bob recommends Touch-Up Solutions Blush Control (available in an 11-ounce aerosol can for $3.99) or Liberon Ring Remover (a wipe-on product in a 125-ml bottle for $11.95). Get both at woodfinishingsupplies.com.

■ **Can you name the bygone tool pictured below and explain its use?**
According to antique tool expert Martin J. Donnelly, this No.1 "Odd Jobs" Combination Tool was made in 1887 as part of the Stanley Rule & Level line. It includes a try square, level, mortising gauge, marking gauge, compass, and T-square.



This late 1800s Stanley tool served as the predecessor to today's combination square.

Photo: courtesy of mjdtools.com

■ **What's the best way to rid mold from your lumber stack?**
Mold fungi forms in humid conditions. It appears as black or greenish-black discoloration on the surface of wood. While it doesn't damage wood, it may indicate the presence of decay fungi, something that can weaken wood structurally.

To get rid of mold, you have two choices: 1) wash the wood with a 1:4 bleach/water solution or 2) don a dust mask and plane the wood outdoors with a thickness planer. Be aware that mold spores can set off an allergic reaction. For this reason, sanding is *not* an option. As a further measure, elevate your lumber stack at least a foot off the ground to protect it from further moisture exposure.

Mold, such as this, can be washed off with a water/bleach solution.

YOU'RE PROBABLY JUST AS AMBITIOUS.

Whether you are a do-it-yourselfer, a professional woodworker or somewhere in between, you have a world full of projects in the home or in the shop that will be easier and more enjoyable to complete when you use quality clamps, bench vises and miter boxes/saws from the Adjustable Clamp Company. Look for them under the Jorgensen, Adjustable and *Pony brand names wherever* fine tools are sold.

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shop tips

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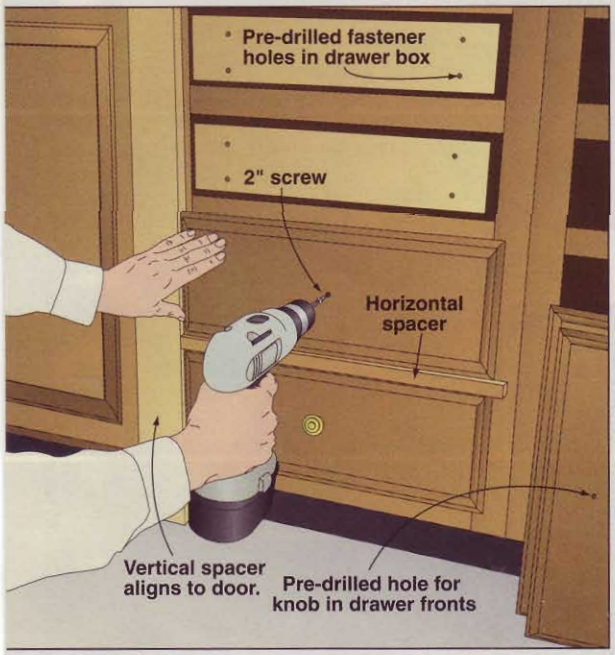
Just say "no" to alignment woes

It's a tricky, time-consuming business to install overlay drawer fronts. The tough parts: aligning the fronts with each other and any adjacent doors and keeping the spacing consistent. To solve these problems, I use a very simple and fast technique—spacers.

top shop tip


Pre-drilled fastener holes in drawer box
2" screw
Horizontal spacer
Vertical spacer aligns to door.
Pre-drilled hole for knob in drawer fronts

First, install the drawer boxes in the cabinet. Pre-drill the fastener holes in the drawer box, where shown. Next, pre-drill the center-pull bolt locations in the false drawer front with a 5/32" bit. These bolt holes must be square to the front's surface. (I use a drill press.)

Starting with the bottom drawer, set the vertical spacer in place, as shown, and hold the false front against the face frame with its bottom edge parallel to the face frame. Drive a 2" screw through the bolt hole as shown, drawing the drawer box tight against the false front. Then, pull the drawer box out, clamp the drawer front to the box at both ends to keep it from rotating, and attach the front through the pre-drilled holes.

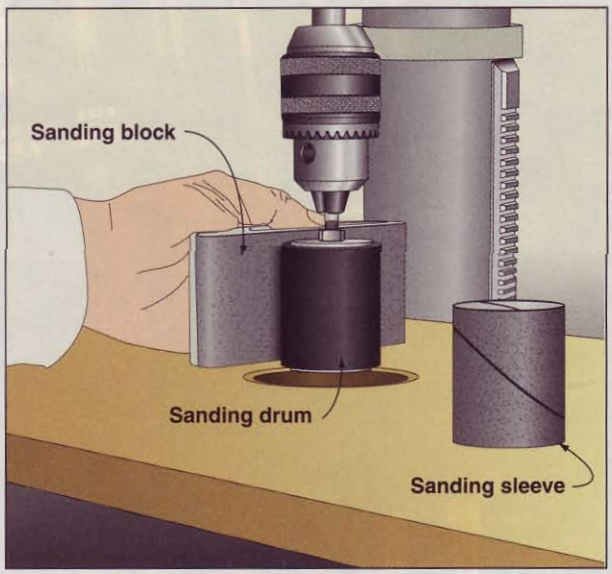
Finally, remove the 2" screw and install the pull. If the pull's screw is too short, counterbore the screw hole from the inside out. Repeat this technique for the remaining drawer fronts, using a horizontal spacer, as shown.

—Dennis Strahle, Eagle, Mich.

Role reversal for sanding drum helps sleeves slip on

I grew tired of trying to slide tight-fitting sanding sleeves over the rubber of my drill-press sanding drums. To loosen the fit for installation, I mounted the sanding drum in my drill press with the drum loosened for changing sleeves. Then, I laid a flat sanding block with 80-grit paper against the drum while it spun at a low speed. In only a few seconds, I took the drum diameter down just enough for the sleeve to easily slide over the loose drum. The drum still tightens firmly on the sleeve for sanding, and I don't have to struggle to change sleeves.

—Brent Hepker, Onida, S.D.



Continued on page 30

Our Winner

Ronald R. Jones, Jr./Edwards Photographic Studio

At the last house Dennis Strahle owned, he made all of the cabinets in the kitchen and bathrooms from red oak harvested from property the house stood on. "At the time, I owned an old Belsaw circular sawmill with a 50" blade," says our Top Shop Tip winner. For their new house, he again built the cabinets, and installing all those doors and drawer fronts inspired the award-winning tip at *left*.

Dennis Strahle receives a 1-hp dust collector (model DC1BXL-CF) from Penn State Industries for sending in this issue's Top Shop Tip. Thanks, Dennis!

Top tips win tools!

Describe how you've solved a workshop dilemma, and you'll earn $75 if it appears here. And, if your tip garners Top Shop Tip honors, you'll also win a tool prize worth at least $250.

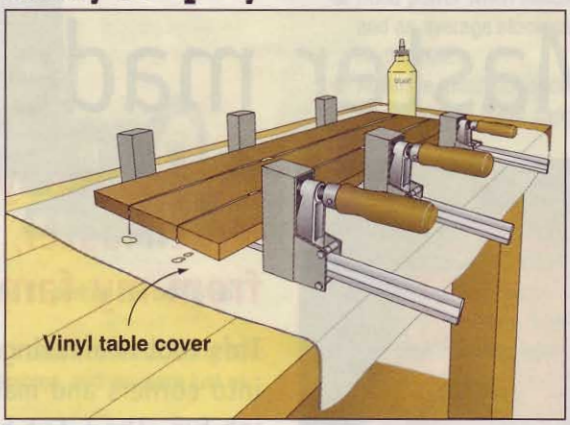
Send your best tips, along with photos or illustrations and your daytime telephone number, to: **Shop Tips, *WOOD*® Magazine, 1716 Locust St., GA-310, Des Moines, IA 50309-3023**. Or e-mail tips to: **shoptips@woodmagazine.com**. Remember to include your contact info in the e-mail as well.

Because we try to publish only original tips, please send your tips only to *WOOD* magazine. Sorry, but submitted materials can't be returned.

Workbench table set for messy company

Keeping glue off the workbench is an ongoing problem for most woodworkers. To preserve my benchtop, I use an inexpensive vinyl table cover from a discount store. Before doing glue-ups or finishing work, I cover the benchtop with this heavy vinyl. With the glue-up complete, the dried glue brushes off the vinyl with little effort. The table covers come in a variety of sizes and they last longer, store easier, and are more pliable than poly sheeting.

—Bill Martin, Lewisburg, Tenn.



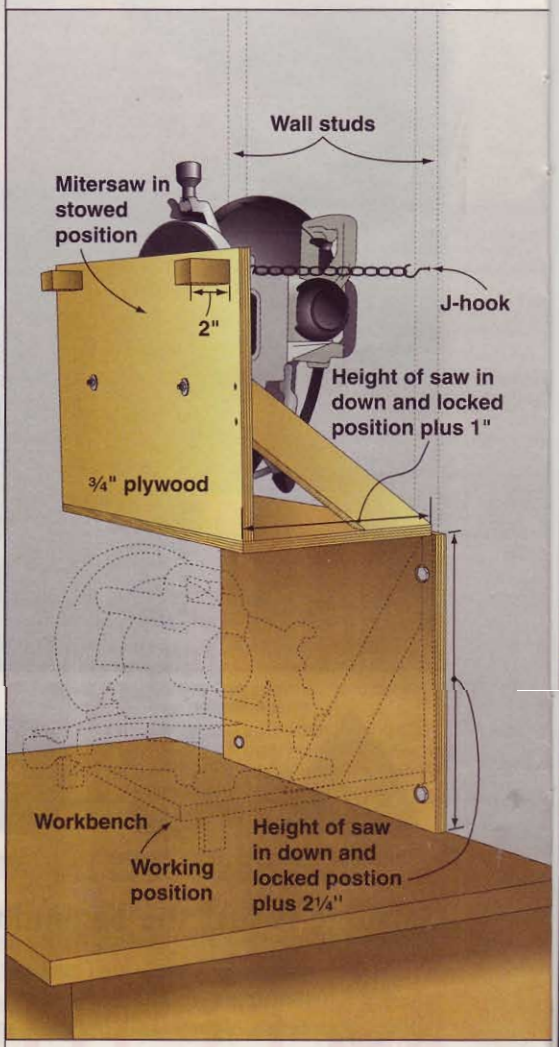
Drop-down tools preserve workbench space

In my small shop, keeping tools handy—and my workbench clear—is a constant challenge. One solution I developed is this drop-down storage platform for some of my busier benchtop tools.

First, I attach a plywood mounting plate to at least two wall studs above the workbench. Next, I build the platform, as shown *below*, varying the width according to the tool being stored. I build the platform base deep enough to accommodate dust-hose attachments, and then add a brace that clears the tool's fence.

A continuous hinge holds the platform to the mounting plate, and J-hooks and chain hold the tool secure while it's stowed away. Once the tool is bolted to the platform, I don't even have to worry about clamping it down when working with heavy, awkward pieces.

—Frank Riester, Asheville, N.C.



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Quartersawn skin puts eye-popping grain all around

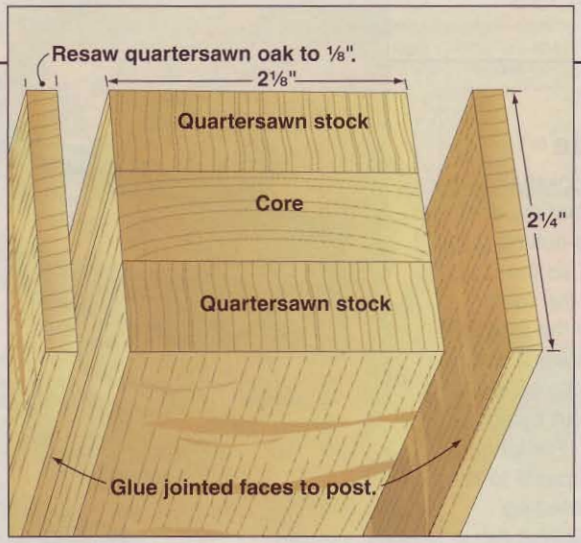
The Mission bed project on *page 40* shows the best method for putting ray-flecked quartersawn grain on all four sides of a post or table leg (something even Mother Nature can't do). That technique, however, requires a highly accurate tablesaw to bevel the edges of the leg wraps. Here's an alternate method that doesn't demand as much precision and yields quartersawn figure on nearly all surfaces.

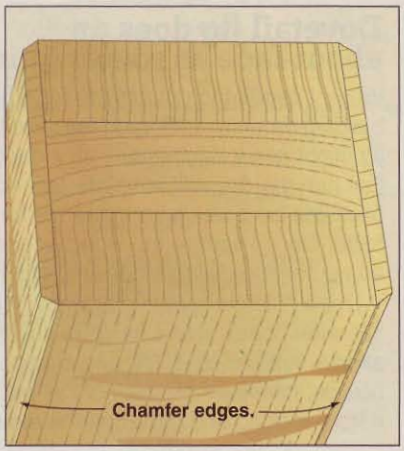
For a 2¼"-square post, rip two pieces of ¾" quartersawn stock and a "core" of scrap ¾" oak to 2⅛". Laminate the three pieces together, as shown, and set the assembly aside.

Joint opposite faces of a ¾×2¼" quartersawn blank, and then resaw one face into a ⅛"-thick veneer. After jointing the freshly cut face of the blank, resaw another ⅛" veneer. (You'll have one resawn piece left over for the next post.) Glue two faces—jointed side in—to the laminated post as shown.

After the glue dries, joint the veneered faces of the post and then plane the post to its final 2¼" thickness, turning it top-for-bottom on alternate passes. This reduces each veneered face to 1/16" thick. Chamfer the four corners of the post to blend the grain and hide the joint.

—Jan Svec, WOOD® magazine project editor



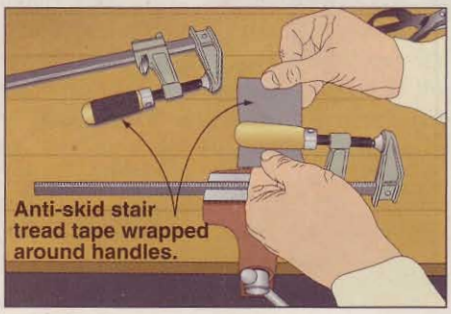


Continued on page 32

Raising the bar for clamp grips

Many of the clamps I use, particularly bar clamps, have wooden or plastic handles that seem slick, especially for dry hands. To give the handle some "tooth" for gripping, I wrap self-sticking anti-skid stair tread tape around the handle. (You can find it at most home centers.) One roll of this gritty stuff lets you get a grip on a lot of handles.

—Dennis Peterson, Lewiston, Idaho



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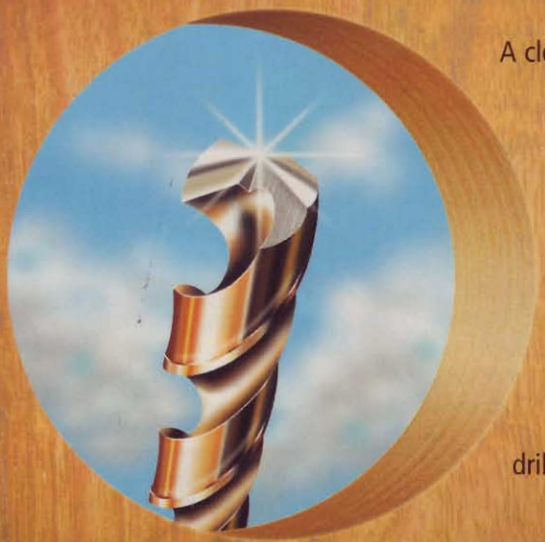

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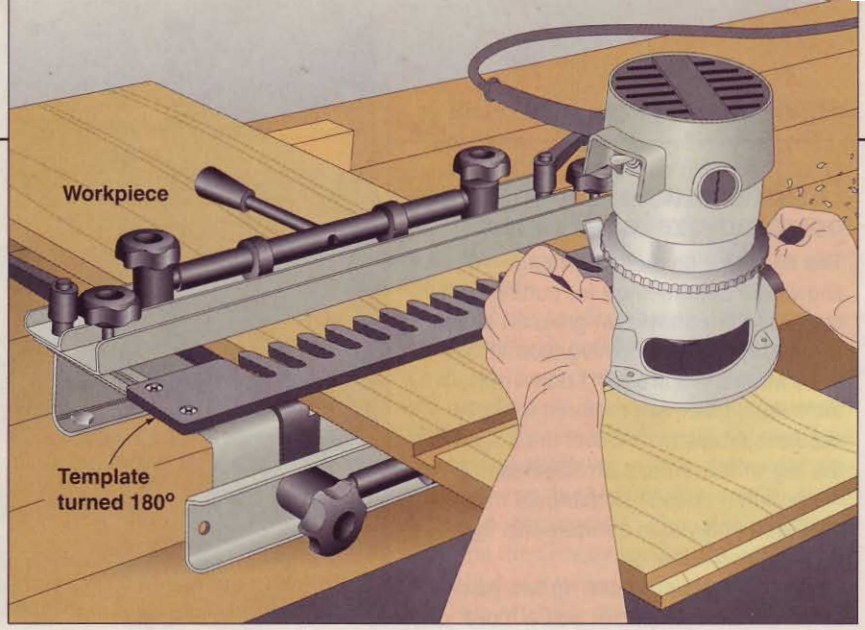
Dovetail jig does an about-face as router guide

When I needed to cut dadoes for a bookshelf I was building recently, I hit upon the idea that my dovetail jig might serve double-duty as a dado-cutting guide. I just turn the dovetail template around so the backside becomes a straightedge for the router base. Once I square the workpiece to the straightedge, the dovetail jig's upper clamp holds it securely.

This single-clamp system, which takes up to a 13"-wide board, works much better than trying to align a straight edge with two clamps. For long boards, I support the back of the workpiece to keep it from racking and distorting the elevated jig.

—Martin Staebell, Batavia, N.Y.



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Workbench, December 2003

WOODWORKER'S JOURNAL

"Versatility and ease of use make either of these systems sure winners for building cabinets and face frames on a regular basis."

Chris Marshall, Woodworker's Journal, February 2004

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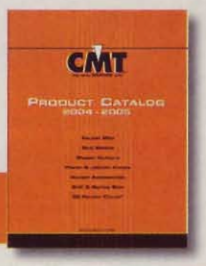

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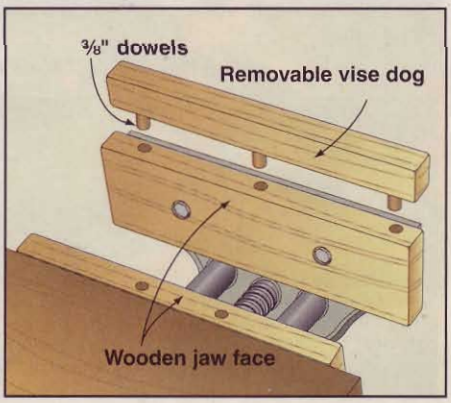
Every good bench vise deserves a dog

I liked your Shop Tip in *WOOD®* magazine issue 152 about making a movable jaw face to add function to a dogless vise. However, my method is faster to set up and more versatile.

To attach a dog for straight edge clamping, drill three ⅜" holes in the top of the movable jaw's wooden face. Keep the holes somewhat close to the metal jaw in order not to weaken the wooden face. Using dowel centers, transfer the hole locations to a removable vise dog made of ¾×¾" hardwood, and drill three matching holes. Glue three dowels or metal rods into the removable dog, and it will be ready to pop into place when you need it. The dog's long face spreads pressure over a wide area and reduces the chance of marring the workpiece.

To clamp small, irregular, or round workpieces, drill two similar holes in the stationary face, as shown, and then place a combination of dowels into any of the five jaw holes for holding those pieces. When the dogs are not in use, tape over the holes to keep sawdust from falling inside.

—Frank Penicka, Mount Pearl, Newfoundland



Towels on tools rub out rust problem

After years of frequent scraping, scouring, sanding, rubbing, and waxing to maintain rust-free cast-iron tool tables in my shop near humid Houston, I found a very simple way to keep the rust from forming in the first place: Lay heavy cotton bath towels over the tools. A large bath towel on my saw table, held in place by the fence, and one spread over the ways of my lathe keep rust at bay and save me countless hours of cleaning.

My wife has sewn towels into fitted covers for my planer, jointer, and other tools. Of course, they also keep out dust. I started out with ragbag towels, but now have bought nice fluffy new ones to keep my tools dust- and rust-free.

—Joe Marsh, Spring, Texas

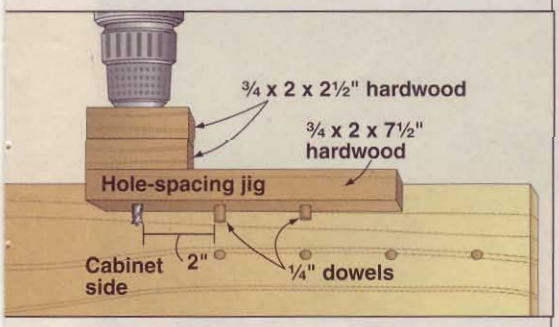
Drill guide spaces holes, and keeps them in line

Because I don't own a drill press, I wasn't looking forward to drilling a bunch of equally spaced holes for shelf pins in the sides of a cabinet. My prospects brightened when I came up with the self-aligning, self-spacing jig for use with a portable drill, shown *below*.

I made it from three pieces of oak, glued together as shown, and two short ¼" dowels. I laid out three ¼" holes on 2" centers (the size and spacing for my shelf pins) along the centerline on the bottom of the jig, with the center of the first hole—the guide hole—1" from the thick end. I used a drill guide (McFeely's part no. DG-3637, $39, 800/443-7937 or www.mcfeelys.com) to drill the three holes perpendicular to the base.

After marking and drilling the first two holes in the series, I indexed the jig's dowels in the cabinet-side holes, and drilled the third hole. I then simply stepped the jig up one hole each time to drill the rest.

—Jim Laine, Hillsborough, N.J.



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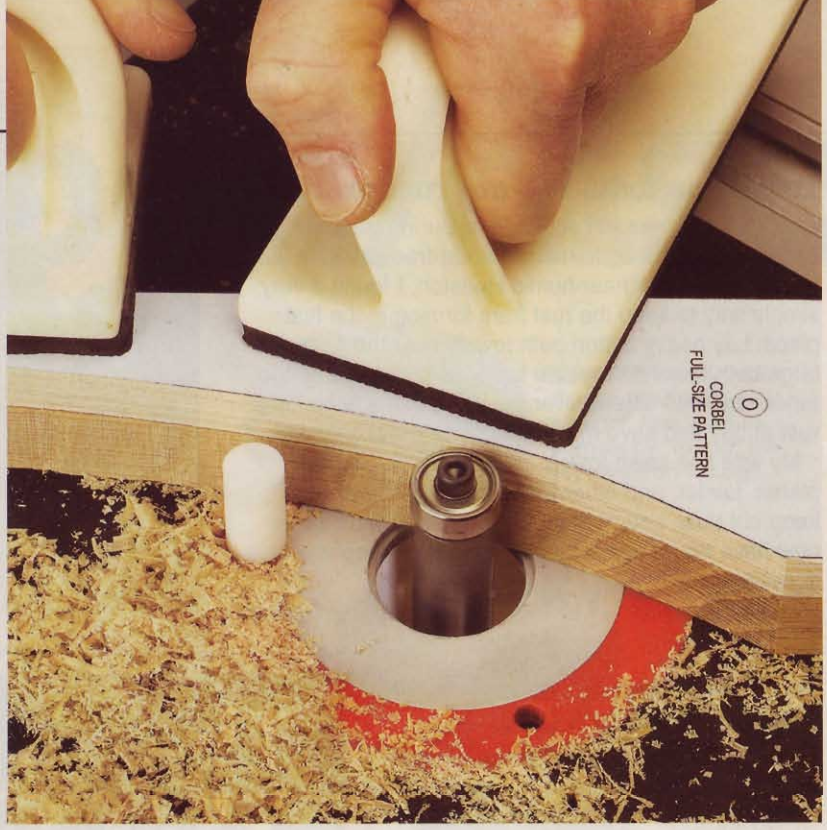
fast, accurate template routing

From machining to bit selection, here's the quick way to make identical parts.



When you need several copies of curved parts, such as the corbels for the mission bed on *page 40*, consider pattern routing. Using a pattern-based template and a router bit designed to follow it, you'll speed through the drudgery of making duplicate parts without sacrificing quality. By keeping a battery of templates, you also can save time on projects you decide to repeat.

Start the job on paper

The shape for your template can come from the *WOOD*® magazine pattern pack, a part from an existing piece of furniture, or a design you draw. If you start from scratch, work out the curve or curves on paper using a lead-core, flexible-curve ruler (available through art supply or wood working stores); a French curve; an extra-long profile gauge; a compass, or any object that serves as a tracing model.

Of course, pattern-based templates have their limits. A router bit can't reproduce a sharp inside angle or inside curve with a radius less than the radius of the bit. Either avoid those details in your design or plan to complete them using other tools, such as a scrollsaw or bandsaw, after routing the rest of the shape.

Begin with a paper pattern. Cut out its straight lines using a knife and straightedge. Use scissors to cut curves roughly ½" outside of the marked curved lines.

Make the template

Tempered ¼" hardboard makes an economical template, but we prefer ½" Baltic birch plywood. Both materials are free of voids—a vital feature for smooth routing—but the extra thickness of the Baltic birch plywood gives the router's bearing ample room to roll along.

Spray-adhere the paper pattern to the rigid template material, matching the straight edges wherever possible to reduce the amount of cutting required.

Bandsaw the pattern curves, as shown in **Photo A**. We used a ½" blade, cutting 1/16" outside the cutline. Rely on a scrollsaw if your design includes curves that are too tight for a bandsaw blade.

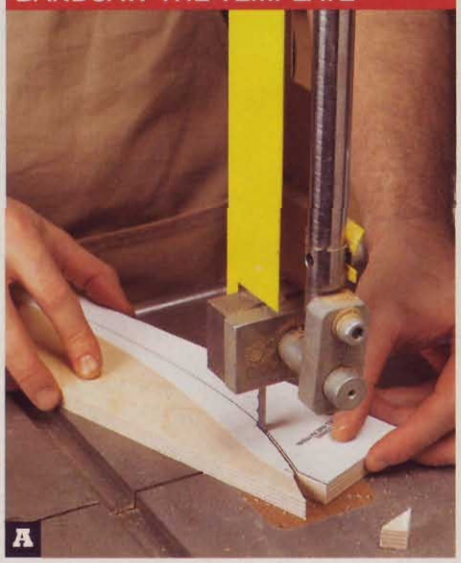
If you don't have an oscillating spindle sander, install a sanding drum with 80-grit sandpaper on your drill press. Double-check that you have a 90° angle between the drum and the drill press table. Sand the curved template edges to the paper pattern lines, as shown in **Photo B**.

Get ready to rout

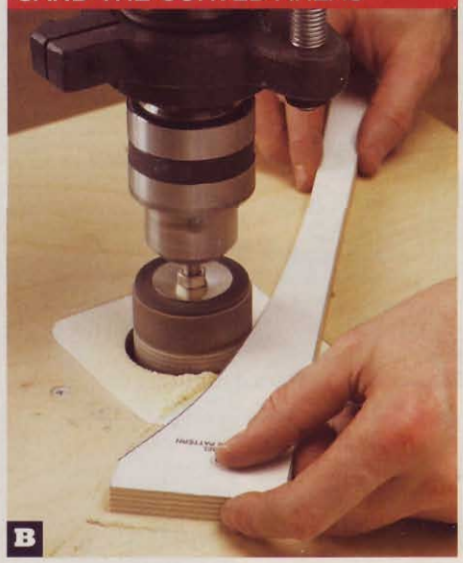
Trace the shape of the finished template on your workpiece, aligning straight edges wherever possible. Rough-cut your

Continued on page 36

BANDSAW THE TEMPLATE

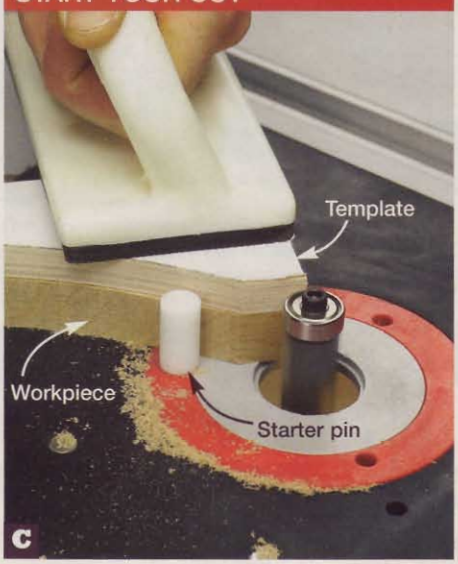


SAND THE CURVED AREAS



workpiece to 1/16–1/8" from the edge of its finished form to reduce the amount of work your bit will need to do.

START YOUR CUT



Next, temporarily adhere the template to the workpiece using double-faced tape, aligning straight edges wherever possible. Whether the pattern will go on the top or bottom of the workpiece depends on whether you're routing freehand or on a table and on your choice of bits.

As seen on the chart *below*, you have several bit choices for pattern routing. On flush-trim bits, the bearing mounts to the end. On a pattern bit, it's between the shank and the cutting body.

Take advantage of your router table when working with small or narrow parts. You can use a flush-trim or pattern bit here, but we prefer the flush-trim's top-mounted bearing because a pattern bit exposes the spinning cutter above the workpiece. For pieces that are too large or awkward for the router table, use a handheld router.

Shape the parts

Adjust the height of the router bit so its bearing rides on the center of the template's edge with the bit's cutting edge spanning the thickness of your workpiece. Don't worry about cutting into the template; the bit's cutting diameter is sized to match the bearing.

A starter pin placed as near as safely possible to the bit, as shown in **Photo C**, will help brace your work as you feed it into the bit. For small pieces, use push-blocks to keep the template firmly against the bearing while protecting your fingers, as shown in the top photo on *page 34*.

You'll get the highest quality sand-free edges with spiral- or sheer-cutting bits. Feed wood in a steady, fluid motion along the piloted bit. By cutting the end grain sections first, you can significantly reduce the chance of tear-out on the remaining edges of the workpiece.

After you're finished, cleanly peel the template and double-faced tape away from your workpiece. Remove any adhesive using paint thinner. Sand off any fine splinters or machine marks if needed.

Flush-Trim and Pattern Bit Sampler

Bit Type	Flush-trim	Spiral flush-trim (upcut)	Spiral flush-trim (downcut)	Downshear flush-trim	Combination upcut/downcut	Double-bearing flush-trim	Pattern
Size Ranges	3/8–7/8" dia.; 1/2–2" cutting length	1/8–1 1/8" dia.; 3/8–2 1/2" cutting length	1/4–1/2" dia.; 3/8–2" cutting length	1/2–3/4" dia.; 1/2–2" cutting length	3/4" dia.; 1 1/8–1 5/8" cutting length	1/2–3/4" dia.; 1–1 1/4" cutting length	5/16–2" dia.; 1/2–2" cutting length
Pattern Location on Workpiece	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: top Handheld: bottom	Table: either Handheld: either	Table: bottom Handheld: top
Comments	Adequate for most work. As with all carbide bits, look for micrograin carbide.	Blades slice at an angle for a smooth cut; upcut bits work best for table-mounted routers.	Steep spiral makes smooth slices, especially in laminated materials such as plywood; downcut versions work best for handheld routing.*	Blades slice at an angle for a smooth cut; downshear is best for handheld work while available upshear versions are best for table work.	Slices through thin veneers of plywood with less chipping on both faces.†	One bit works on both handheld and table-mounted routers for either pattern routing or flush-trim work such as laminates.‡	Top bearing lets template be attached atop a workpiece for handheld routing.

Hard-to-find bits: *from MLCS (800/533-9298); † from Woodhaven (800/344-6657); ‡ from Eagle America (800/872-2511)

top-drawer blade organizer

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WOOD MAGAZINE'S IDEA SHOP 5

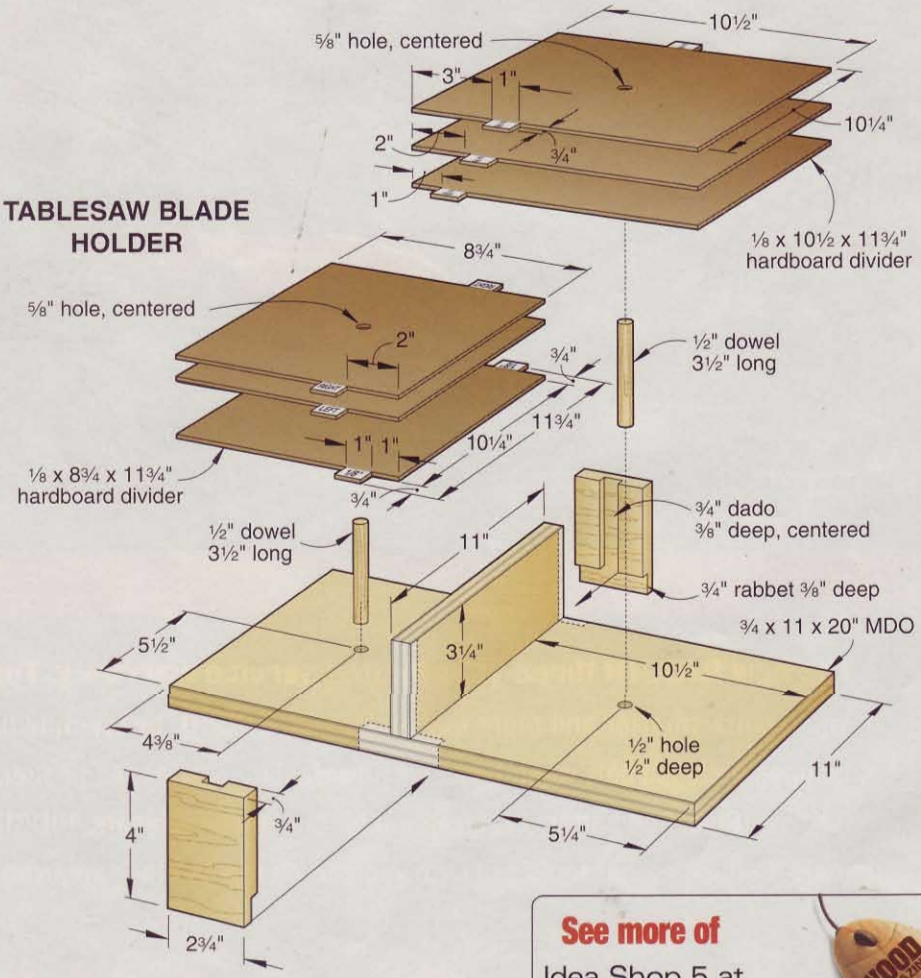
This handy divider lets you organize and protect your favorite saw blades. We dimensioned ours to fit into a drawer in the sawing/routing center shown on page 62 of issue 151 of *WOOD*®. Feel free to modify your organizer to suit a drawer you have in mind.

To build your own, use the drawing at *right* to cut all the pieces to size, noting the locations of the extending ¾×1" tabs on each divider. For our 10" blades we used the wider dividers on the right; for our 8" dado set, the narrow dividers are on the left.

Drill two ½" holes in the base piece where dimensioned, and glue a ½" dowel 3½" long into each. Next, drill a ⅝" hole into each ⅛" hardboard divider. The dividers slide over the ½" dowels to separate saw blades while preventing the teeth from contacting and damaging one another. Mark the tab of each hardboard divider with the appropriate blade description, and set that blade on top of that particular divider.

Project design: **Jeff Mertz**

TABLESAW BLADE HOLDER

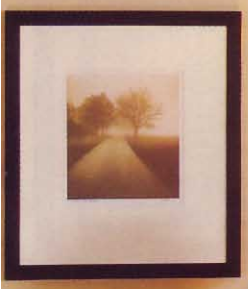


See more of Idea Shop 5 at **woodmagazine.com/IS5**

HEIRLOOM-QUALITY

ARTS & CRAFTS BED

Whether you need a double, queen, or king, this bed fills the bill, and does so in grand style.



Stay tuned for the companion pieces...

Interested in building matching pieces or a complete bedroom ensemble? You'll find plans for the nightstand (*above*) in the November 2004 issue, the dresser and mirror (*left*) in the December 2004 issue, and the blanket chest (*below*) in the February 2005 issue.

This elegant project is a dream come true. By simply changing the dimensions of a few parts and the quantity of spindles, as specified in the **Materials List**, you can build the bed in double, queen, or king size.

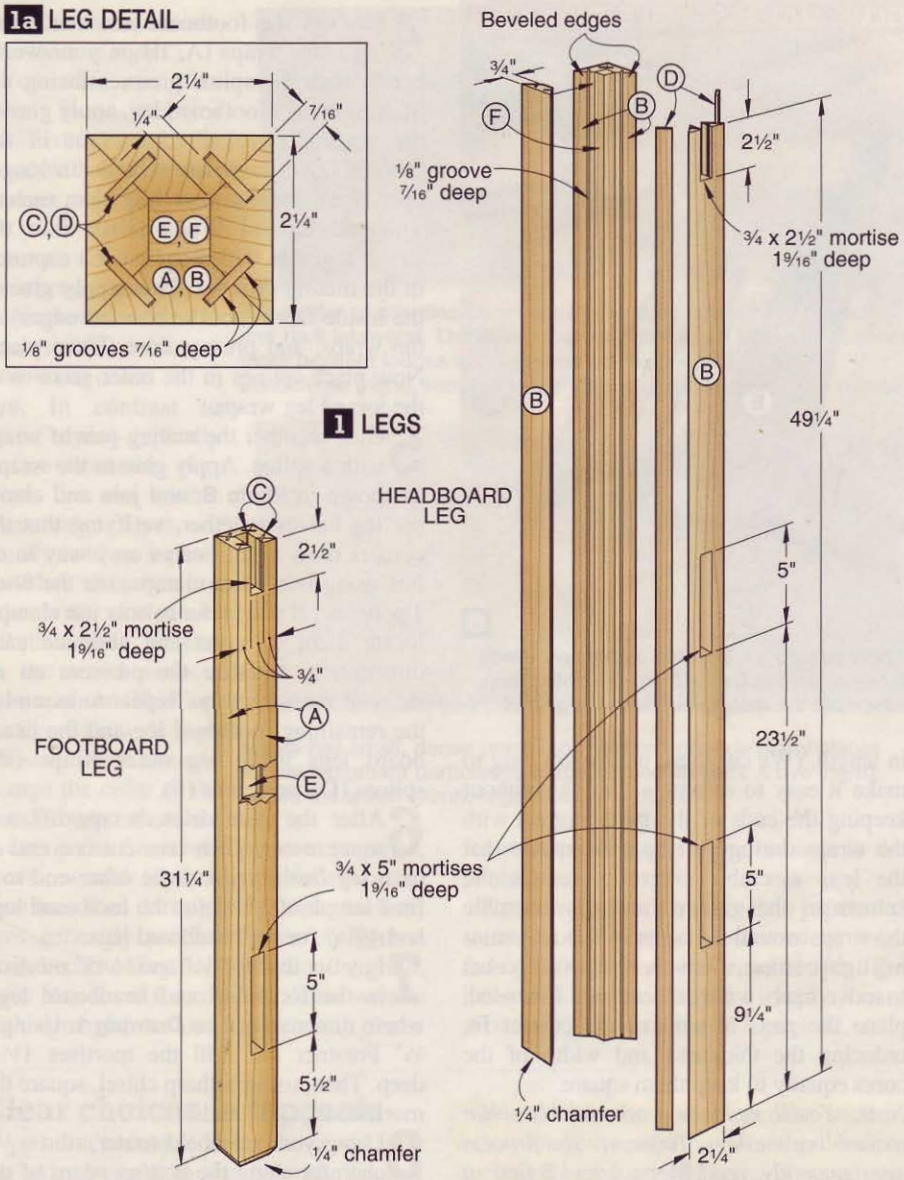
You can rest easy about installing the spindles because there's no need for repetitive drilling and chiseling of mortises. Instead, thanks to a simple indexing jig, you'll cut notched spindle strips that install into the grooves in the footboard and headboard rails, ensuring consistent spindle fit and perfect alignment.

***Note:** To display quartersawn white oak ray fleck on all faces of the footboard and headboard legs, we made them by assembling four leg outer wraps (A, B) with splines (C, D) around cores (E, F) in the configuration shown on* **Drawings 1** *and* **1a**. *As an option, you can construct figured legs without bevel-cutting long parts. See the* **Shop Tip** *on* page 31. *Also, if you plan to use plain-sawn wood, consider making solid legs from laminated 4/4 stock to the finished sizes listed in the* **Materials List**. *Then continue with* **Step 7** *to lay out the mortises for the rail tenons.*

For the board feet of lumber and other items needed to build this project, see *page 46*.

1a LEG DETAIL

1 LEGS



Start by wrapping up some fabulous legs

1 From ¾"-thick stock, cut eight footboard leg outer wraps (A) to 2½" wide and 32¼" long and eight headboard leg outer wraps (B) to the same width and 50¼" long. Angle your tablesaw blade to a precise 45°, and bevel-rip both edges of the wraps for a final width of 2¼". If your stock has any warp, use a feather board clamped to your rip fence to hold the stock firmly against the saw table.

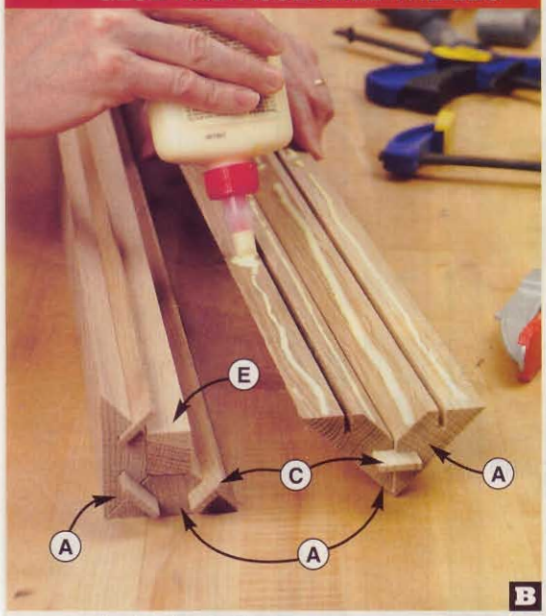
2 With your fence positioned on the opposite side of the saw blade, cut angled ⅛" grooves 7/16" deep in the leg outer wrap beveled edges to receive the footboard and headboard leg splines (C, D), where dimensioned on **Drawings 1** and **1a** and as shown in **Photo A**.

3 Cut the footboard and headboard leg splines (C, D) and leg cores (E, F) to the sizes listed in the **Materials List** but 2" longer

CUT GROOVES IN THE LEG WRAPS

Keeping each leg outer wrap tight against the saw table and fence, cut a ⅛" groove 7/16" deep along each of the beveled edges.

GLUE AND ASSEMBLE THE LEG



Apply glue to the beveled edges and inside faces of the leg half without the core. Then assemble the mating leg halves together.

in length. (We cut these parts extra long to make it easy to assemble the legs without keeping the ends of the parts aligned with the wraps during glue-up.) To ensure that the legs assemble correctly, test-fit the splines in the grooves and dry-assemble the wraps around the cores. While maintaining tight corners, allow the splines and cores to move freely without looseness. If needed, plane the parts to achieve the correct fit, reducing the thickness and width of the cores equally to keep them square.

Note: You'll need to work quickly when assembling the legs. To ensure the process goes smoothly, read **Steps 4** *and* **5** *first so you understand the procedures and have all of the parts laid out and the supplies at hand.*

4 Lay out the footboard and headboard leg outer wraps (A, B) on your workbench with the spline grooves facing up. Starting with a footboard leg, apply glue to the mating beveled edges (not in the grooves) of two wraps (A). For a longer open time, use a slow-setting glue, such as Titebond Extend Wood Glue. Join the wraps together with a spline (C) captured in the mating grooves. Then apply glue to the inside faces (not the beveled edges) of the wraps, and press a core (E) in place. Now place splines in the outer grooves of the joined leg wraps.

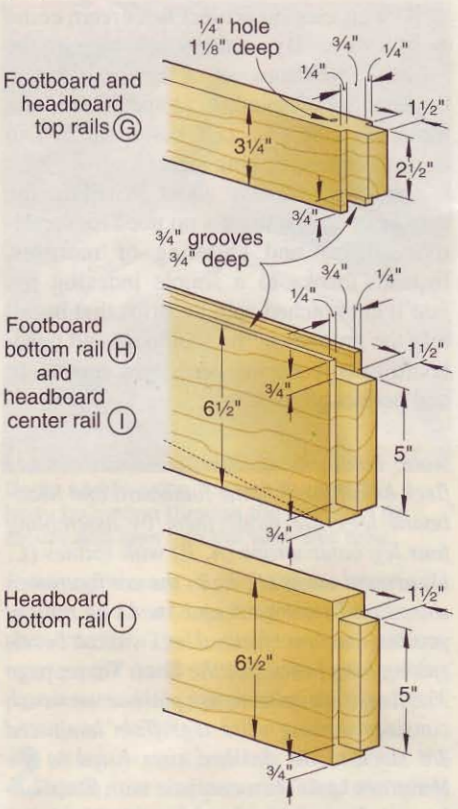
5 Glue together the mating pair of wraps with a spline. Apply glue to the wraps, as shown in **Photo B**, and join and clamp the leg halves together, verifying that the corners draw tight. For an easy way to do this using minimum clamps, see the **Shop Tip**, *below*. If you prefer to only use clamps, locate them 6" apart and alternate each direction to equalize the pressure on all sides of the assembly. Repeat to assemble the remaining footboard leg and the headboard legs using leg outer wraps (B), splines (D), and cores (F).

6 After the glue dries, scrape off any squeeze-out. Then crosscut one end of each leg flush, and cut the other end to a final length of 31¼" for the footboard legs and 49¼" for the headboard legs.

7 Lay out the ¾×2½" and ¾×5" mortises in the footboard and headboard legs, where dimensioned on **Drawing 1**. Using a ¾" Forstner bit, drill the mortises 1⁹⁄₁₆" deep. Then, using a sharp chisel, square the mortise sides and ends.

8 Using your handheld router, rout a ¼" chamfer along the bottom edges of the legs. Now sand the legs smooth with 220-grit sandpaper.

2 RAIL TENON DETAILS



Next craft the rails for the headboard and footboard

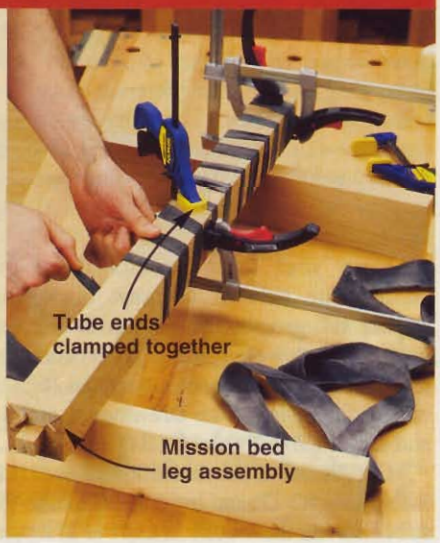
1 From 1½" or laminated ¾" stock planed to 1¼" thick, cut the footboard and headboard top rails (G), footboard bottom rail (H), and headboard center and bottom rails (I) to the sizes listed. Save your cutoffs for making test tenons.

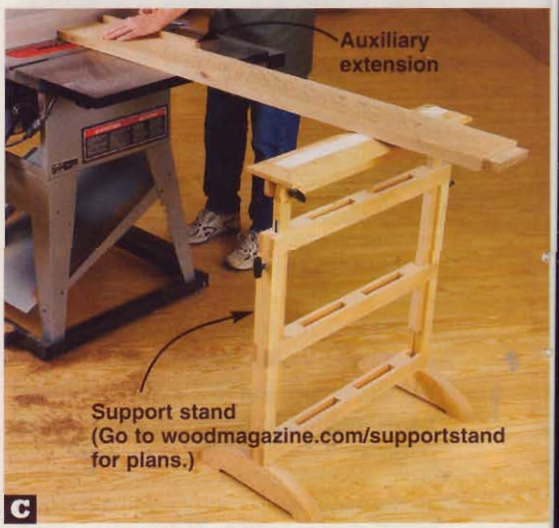
2 Fit your tablesaw with a ¾" dado blade. Then cut a ¾"-deep groove centered along one edge of the footboard and headboard top rails (G), footboard bottom rail (H), and headboard center rail (I), where shown on **Drawing 2**.

SHOP TIP

Inner tubes make handy "clamps" for special glue-ups

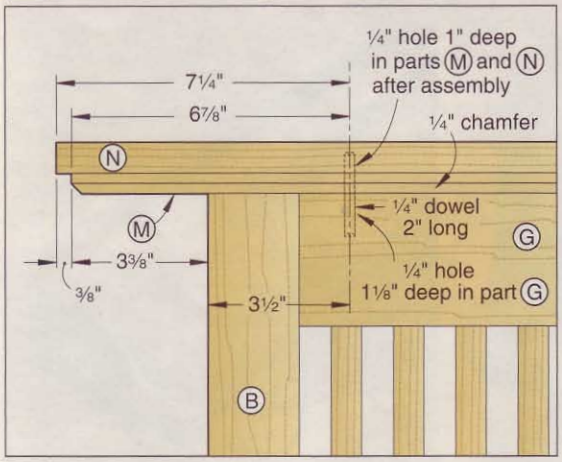
Do you have some old bicycle inner tubes hanging around? If so, here's a unique way to get more mileage out of them. When gluing together long multi-sided assemblies, such as the Mission bed legs, first slice the tube into one long length. Then slice this into two long strips. Remove the valve stem. Clamp a tube at one end, wrap it around the assembly, and clamp it again at the other end, as shown at *right*. (You'll need two tubes to cover the lengths of the bed legs.) If you don't have tubes, you can buy new ones for under $5—a fraction of the cost of buying a lot of clamps.



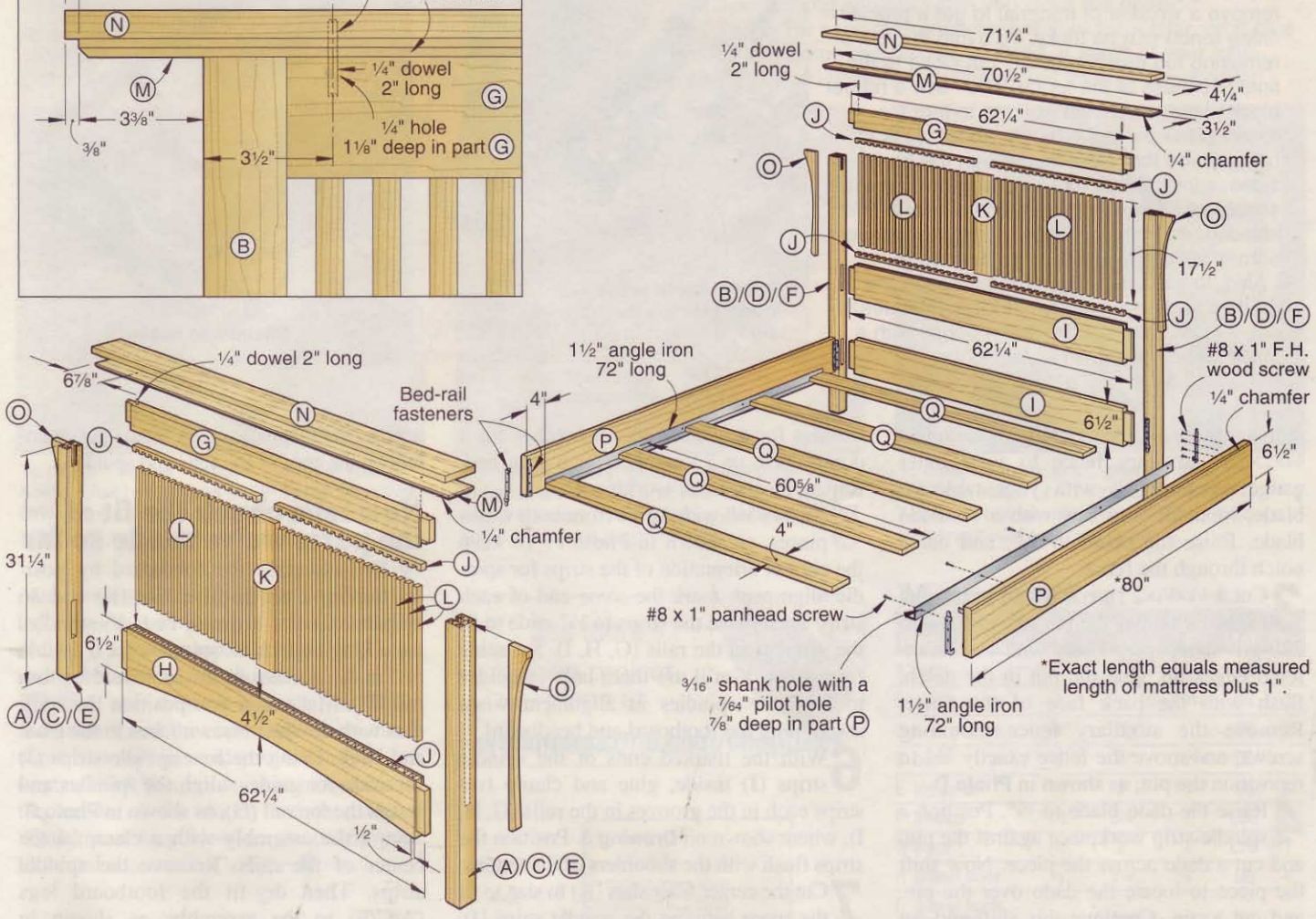


Use a support stand and an auxiliary extension on your miter gauge to safely hold and guide the rails when cutting the tenons.

3a TOP MOUNTING DETAIL



3 EXPLODED VIEW
(Queen-size bed shown)



3 To form tenons on the ends of the rails, where shown, lower the dado blade to ¼". (We made test tenons on our cutoffs and verified their fit in the leg mortises before cutting the tenons on the rails.) Then make cheek cuts to form ¾" tenons 1½" long on the rails. For safety, support the rails as shown in **Photo C**. Raise the blade to ¾". With rails H and I placed on edge, trim the tenons to 5" wide. For an easy way to fine-tune the fit of the tenons, see the **Shop Tip**, on the *next page*.

4 Mark the center and ends of the arch on the footboard bottom rail (H), where dimensioned on **Drawing 3**. Then bend a fairing stick to these points, and draw the arch. (For a free fairing stick plan, go to woodmagazine.com/fairing.) Bandsaw and sand the arch to shape.

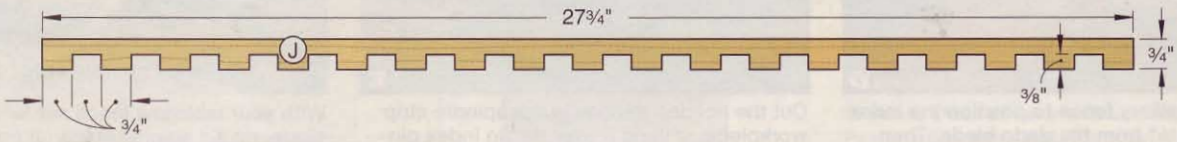
5 Sand the rails (G, H, I) to 220 grit. Then, to keep the rails matched with the footboard and headboard legs, identify the rail left ends and the left legs on the front face using masking tape.

Time for the spindle strips, fillers, and spindles

1 To make the notched spindle strips (J), where shown on **Drawing 4**, cut two ¾×6×27¾" pieces for a queen-size bed, two ¾×6×24¾" pieces for a double bed, or two ¾×6×35¼" pieces for a king bed. Make sure you cut the pieces to identical length so the spindles (L) will align correctly later.

2 To cut precisely spaced dadoes in the pieces to form the notches in the spindle

4 SPINDLE STRIP DETAIL
(For a queen-size bed)

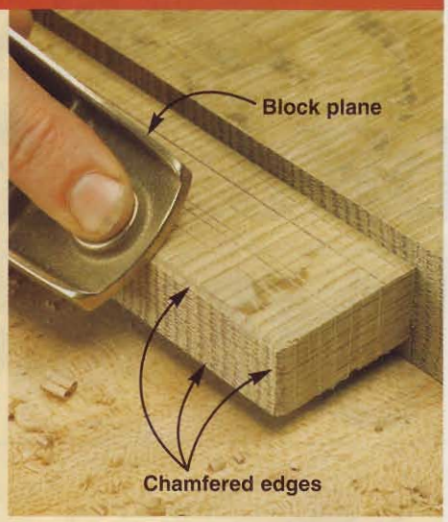


SHOP TIP

Trim tenons with hand planes for an incredible shave and fit

Adjusting your tablesaw blade height to remove a whisker of material to get a precise-fitting tenon can be tricky. To avoid the risk of removing too much material, cut close to the final thickness of the tenon. Then use a rabbet block plane, as shown at *right*, to trim the tenon to the perfect size. (A rabbet block plane has a blade that extends through the body sides, allowing it to trim tenons flush with the shoulders.) Simply adjust the plane for a fine shaving, and take an equal number of passes across both tenon cheeks as needed.

Also, to ease insertion of the tenon in the mortise and give extra room for glue squeeze-out, slightly chamfer the tenon edges with a block plane, as shown at *far right*.



strips, make a simple indexing jig. Screw a ¾×2×36" auxiliary fence to your miter gauge, centering it with your tablesaw blade. Next, fit your saw with a ¾" dado blade. Raise the blade to ¼", and cut a notch through the fence.

3 Cut a ¼×¾×2" piece for an index pin. Lightly chamfer the pin top edges with 220-grit sandpaper. Then, with the chamfered edges up, glue the pin in the notch, flush with the back face of the fence. Remove the auxiliary fence mounting screws, and move the fence exactly ¾" to reposition the pin, as shown in **Photo D**.

4 Raise the dado blade to ⅜". Position a spindle-strip workpiece against the pin, and cut a dado across the piece. Now shift the piece to locate the dado over the pin, and cut again. Continue this shift-and-cut process, as shown in **Photo E**, to form 18 notches for a queen bed, 16 notches for a double bed, or 23 notches for a king bed. Repeat for the other workpiece.

5 Rip six ⅞"-wide strips from both workpieces, as shown in **Photo F**. To keep the correct orientation of the strips for spindle alignment, mark the *same* end of each strip. Then plane the strips to ¾" wide to fit the grooves in the rails (G, H, I). Set aside four strips. You'll use them later as guides to hold the spindles in alignment when assembling the footboard and headboard.

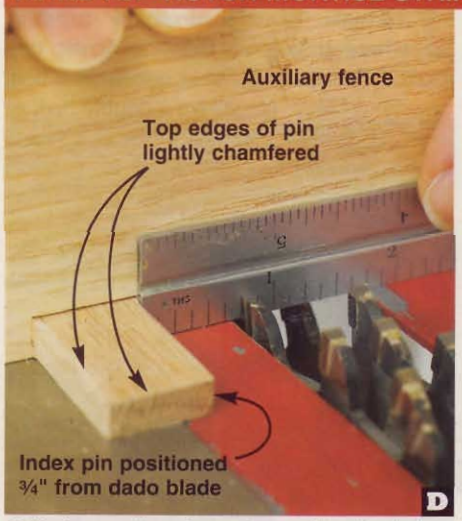
6 With the marked ends of the spindle strips (J) inside, glue and clamp two strips each in the grooves in the rails (G, H, I), where shown on **Drawing 3**. Position the strips flush with the shoulders of the tenons.

7 Cut the center filler slats (K) to size to fit the space between the spindle strips (J). Then cut the spindles (L) to size to fit the notches in the spindle strips. Sand light chamfers on the ends of the slats and spindles.

Now let's check the fit of the parts we've made so far

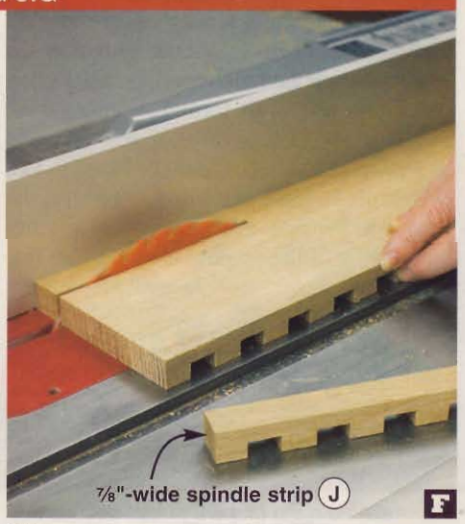
1 Dry-assemble the footboard by positioning a center filler slat (K) and 36 spindles (L) for a queen bed, 46 spindles for a king bed, or 32 spindles for a double bed in the notches in the footboard bottom rail (H). Make sure you position the spindles with the quartersawn faces to the front and back. Using the four spindle strips (J) set aside for guides, align the spindles and install the top rail (G), as shown in **Photo G**. Secure the assembly with a clamp at the center of the rails. Remove the spindle strips. Then dry-fit the footboard legs (A/C/E) to the assembly, as shown in **Photo H**.

MAKE TOP-NOTCH MORTISE STRIPS IN A JIFFY WITH A SIMPLE INDEXING JIG



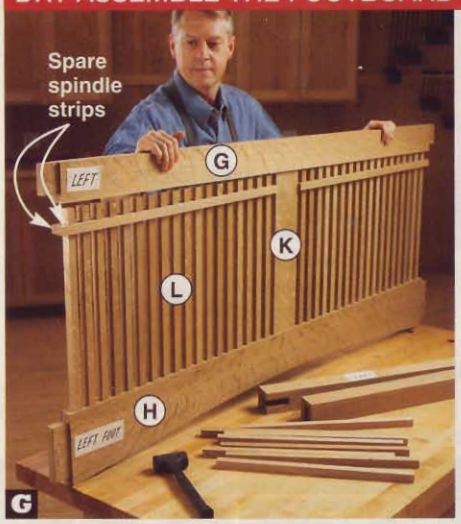
Shift the auxiliary fence to position the index pin exactly ¾" from the dado blade. Then reattach the fence to your miter gauge.

Cut the needed dadoes in the spindle-strip workpiece, shifting it over the jig index pin after each cut.



With your tablesaw fence set ⅞" from the blade, rip six spindle strips (J) from each notched workpiece.

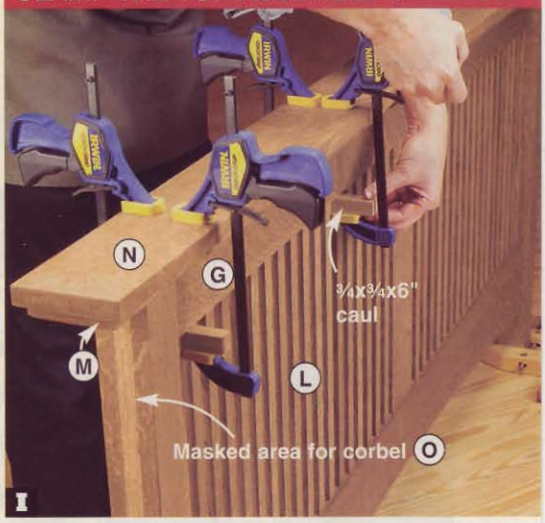
DRY-ASSEMBLE THE FOOTBOARD TO CHECK THE FIT OF THE PARTS



With the marked ends to the inside, position the spare spindle strips on the front and back of the spindles (L) to keep them aligned. Then add the footboard top rail (G).

Dry-assemble and clamp the footboard legs (A/C/E) to the ends of the footboard top and bottom rails (G, H), making sure the legs draw tight against the rail tenon shoulders.

CLAMP THE TOP ASSEMBLY IN PLACE



Inserting the ¾×¾×6" cauls between the spindles (L) and under the top rail (G) in four places (two shown), clamp the top assembly (M/N) to the footboard.

2 Verify that all of the parts fit together correctly. Then sand the center filler slat and spindles. (We used a random-orbit sander on the faces of the parts, and hand-sanded their edges.)

3 Disassemble the footboard. Then transfer the markings on the masking tape to the rail tenons and to the top of the legs, and remove the tape. Sand the legs and rails. Repeat the process to dry-assemble the headboard legs (B/D/F), top rail (G), center and bottom rails (I), center filler slat (K), and spindles (L).

Fashion the tops, corbels, side rails, and support slats

1 Cut the sub tops (M) and tops (N) to size. Rout a ¼" chamfer along the bottom edges of the sub tops, where shown on **Drawings 3** and **3a.** Then glue and clamp the tops centered on the sub tops with a ⅜" overhang all around.

2 Drill ¼" holes 1⅛" deep centered in the top edge of the footboard and headboard top rails (G), where dimensioned on **Drawing 3a**, for ¼" dowels.

3 Insert ¼" dowel centers in the holes in the footboard top rail. Position a top assembly (M/N) on the footboard, centered end-to-end and side-to-side. Press on the assembly to mark the dowel-center locations on the sub top (M). Remove the top assembly and the dowel centers. Now drill ¼" holes 1" deep at the marked locations. Mark the top assembly to keep it matched with the footboard. Repeat for the headboard and its top assembly.

4 Cut the corbels (O) to the size listed. Then photocopy the full-size corbel pattern on the *WOOD Patterns*® insert. Spray-adhere the pattern to a corbel. Now bandsaw the corbel to shape, cutting just outside the pattern line. Sand to the line using a 120-grit sanding drum in your drill press or an oscillating spindle sander. Using this piece as a template, mark the contour on the other corbels. Cut and sand them to shape. For an easy way to make identical corbels by pattern-routing, see the article on *page 34*.

***Note**: Mattress lengths may vary by a couple of inches. To ensure a correct fit in the bed, measure the length of your mattress and cut the side rails (P) to your measurement plus 1".*

5 From 1½" stock planed to 1¼", cut the side rails (P) to size. Rout a ¼" chamfer along the top outside edge of the rails, where shown on **Drawing 3**. Then, from ¾" stock, cut the support slats (Q) to size. Sand the parts smooth.

Head for the finish, and put it all together

1 Mask the top of the footboard legs (A/C/E) and headboard legs (B/D/F); the tenons on the rails (G, H, I); the top edges of rails G; the top and back edges of the corbels (O); and the mating area on the legs for the corbels. (Because it would be difficult to stain the headboard and footboard after assembly due to the narrow spaces between the spindles (L) and legs, we masked and stained the parts individually.)

2 Sand any parts that need it with 220-grit sandpaper. Remove the dust. Then apply a stain to all of the bed parts except for the bottom face of the top assemblies (M/N) and the support slats (Q). (We used Watco Danish Oil Finish, Dark Walnut.)

3 Remove the masking tape. Then assemble the footboard top rail (G), bottom rail (H), center filler slat (K), and spindles (L) as before. Now glue and clamp the legs (A/C/E) to the assembly. Use rubber clamp pads or cardboard between the clamp heads and the assembly to prevent marring of the finish. Repeat to assemble the headboard.

4 Cut four 2"-long pieces from a ¼" oak dowel. Also, from ¾" scrap, cut four ¾×6" pieces for clamping cauls. Apply glue to two dowels, the top edge of the footboard top rail (G), and the top ends of the legs (A/C/E). Insert the dowels in the rail holes. Then clamp the matched top assembly (M/N) in place, as shown in **Photo I**. Repeat to assemble the headboard and its top assembly.

5 Apply glue to the back and top edges of the corbels (O). Then clamp them in place on the headboard and footboard legs under the sub tops (M). After the glue dries, stain and finish the bottom face of the sub tops, and touch up any areas that need it on the legs around the corbels. After the stain dries, top-coat all parts, including the support slats, with a clear finish. (We applied three coats of Aquazar Water-Based Clear Satin Polyurethane, sanding to 320 grit between coats.)

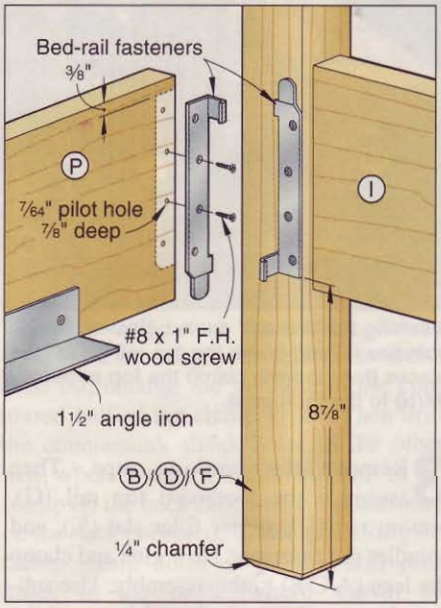
6 To mount the bed-rail fasteners to the headboard and footboard legs and side rails (P), lay out the mating left/right pairs of fasteners, as specified in the instructions supplied with the hardware. Position the fasteners on the parts, where dimensioned on **Drawing 5**. Mark the mounting-hole locations. Then drill 7/64" pilot holes ⅞" deep, and screw the fasteners in place.

7 Cut two pieces of 1½" angle iron to 72" long. Drill 3/16" shank holes through the iron, where shown on **Drawing 3**. Then position the iron on the side rails (P), flush with the bottom and centered end-to-end. Using the holes in the iron as guides, drill 7/64" pilot holes 7/8" deep in the rails. Now screw the iron to the rails.

8 With a helper, assemble the bed, as shown in **Photo J**. Then position the support slats (Q) on the angle iron. For a king-size bed, mount a center bed leg (see **Sources**) to the bottom of the center slat (Q) to prevent sagging, as specified in the instructions supplied with the hardware. Now complete the bed with a box spring, mattress, mattress pad, linens, and comfy pillows, and climb aboard for a well-deserved rest.

Written by **Owen Duvall**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine**

5 BED-RAIL FASTENER DETAIL (Headboard shown)



J

Attach the side rails (P) to the footboard by engaging the bed-rail fasteners. Then join the rails to the headboard.

Materials List

Queen-size bed												
	FINISHED SIZE					Parts differences for						
						King-size bed			Double-size bed			
Part	T	W	L	Matl.	Qty.	W	L	Qty.	W	L	Qty.
A* footboard leg outer wraps	¾"	2¼"	31¼"	QO	8						
B* headboard leg outer wraps	¾"	2¼"	49¼"	QO	8						
C* footboard leg splines	⅛"	¾"	31¼"	O	8						
D* headboard leg splines	⅛"	¾"	49¼"	O	8						
E* footboard leg cores	¾"	¾"	31¼"	O	2						
F* headboard leg cores	¾"	¾"	49¼"	O	2						
G footboard and headbd. top rails	1¼"	3¼"	62¼"	QO	2		78¼"			56¼"	
H footboard bottom rail	1¼"	6½"	62¼"	QO	1		78¼"			56¼"	
I headboard center and bottom rails	1¼"	6½"	62¼"	QO	2		78¼"			56¼"	
J* spindle strips	¾"	¾"	27¾"	QO	8		35¼"			24¾"	
K center filler slats	¾"	3¾"	18¼"	QO	2	4¾"					
L spindles	¾"	¾"	17½"	QO	72			92			64
M sub tops	½"	3½"	70½"	QO	2		86½"			64½"	
N tops	¾"	4¼"	71¼"	QO	2		87¼"			65¼"	
O corbels	¾"	2¾"	20"	QO	4						
P side rails	1¼"	6½"	80"†	QO	2					75"†	
Q support slats	¾"	4"	60⅝"	C	5		76⅝"			54⅝"	

*Parts initially cut oversize. See the instructions.

†The lengths of mattresses can vary. Our queen-size mattress measured 79". To ensure a correct fit, measure the length of your mattress, and add 1" to determine the length of the side rails (P).

***Note:** To make a king-size or double-size bed, cut all of the parts to the sizes and in the quantities listed for the queen-size bed at* left *except for the differences specified* below *for parts G through N, P, and Q.*

Materials key: QO–quartersawn white oak, O–white oak, C–choice of hardwood (2×4s also are suitable).

Supplies: Spray adhesive, ¼" oak dowel 10" long, #8×1" flathead wood screws (32), #8×1" panhead screws (10), 1½" angle iron 72" long (2).

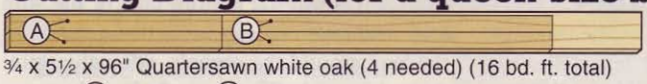
Blades and bits: Stack dado set; ¾" Forstner bit; 45° chamfer router bit.

Sources

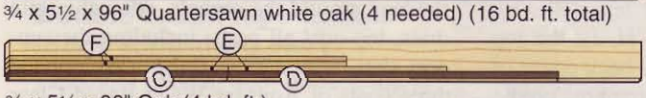
Bed-rail fasteners. 5 11/16" bed-rail fasteners, no. 94K01.01, $6.20 (set of 4 prs.). Call Lee Valley 800/871-8158; leevalley.com.

Center leg for king-size bed. Center bed leg, no. 68429, $12.99. Call Rockler 800/279-4441; rockler.com.

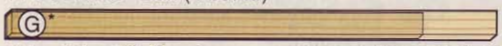
Cutting Diagram (for a queen-size bed)



¾ x 5½ x 96" Quartersawn white oak (4 needed) (16 bd. ft. total)



¾ x 5½ x 96" Oak (4 bd. ft.)

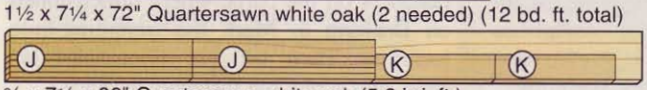


1½ x 3½ x 72" Quartersawn white oak (2 needed) (6 bd. ft. total)

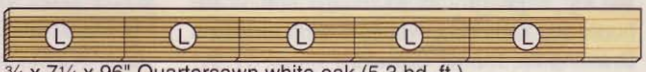
1½ x 7¼ x 72" Quartersawn white oak (6 bd. ft.)

*Plane or resaw to the thicknesses listed in the Materials List.

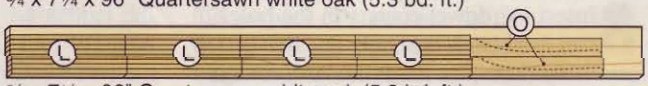
1½ x 7¼ x 72" Quartersawn white oak (2 needed) (12 bd. ft. total)



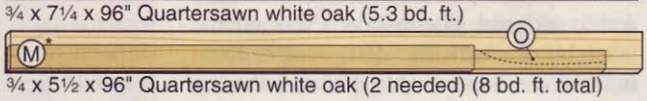
¾ x 7¼ x 96" Quartersawn white oak (5.3 bd. ft.)



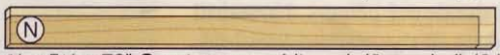
¾ x 7¼ x 96" Quartersawn white oak (5.3 bd. ft.)



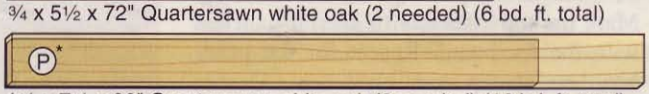
¾ x 7¼ x 96" Quartersawn white oak (5.3 bd. ft.)



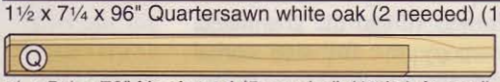
¾ x 5½ x 96" Quartersawn white oak (2 needed) (8 bd. ft. total)



¾ x 5½ x 72" Quartersawn white oak (2 needed) (6 bd. ft. total)



1½ x 7¼ x 96" Quartersawn white oak (2 needed) (16 bd. ft. total)



¾ x 5½ x 72" Hardwood (5 needed) (15 bd. ft. total)

make-it-yourself

mission finish

Combining common stains with a surprise ingredient yields a close copy of traditional Arts and Crafts finishes.

When it comes to Craftsman or Mission-style furniture, the name Gustav Stickley (1858-1942) always comes to mind. Stickley popularized the English Arts and Crafts movement in America through his magazine, *The Craftsman*, and the widely copied furniture he produced. His pieces were original, functional, and elegant in their simplicity, and the methods he developed for coloring wood were sheer genius—even if they were discovered by accident.

According to a history of Stickley, a farmer noticed that raw oak planks in a barn had turned rich shades of brown. Stickley

STEP 1
GATHER YOUR SUPPLIES

Alan's stain formula uses nonfibered roofing tar—made with pure asphalt—mixed with Minwax red oak stain. Minwax natural stain lightens the mixture as desired. Buy "nonfibered" roofing tar or you will have to strain the fibers out before mixing. A thicker tar is available in caulking-style tubes and can be thinned with mineral spirits.

STEP 2
PREPARE THE WOOD SURFACE

Sand to at least 150 grit, and then raise the grain with a damp cloth. Distilled water works best because it contains no chlorine or impurities. After the wood dries, sand with 180 grit just enough to remove the raised wood fibers. Blow or brush off the dust and sanding particles, making certain you get all of the dust out of the pours.

STEP 3
CREATE YOUR CUSTOM STAIN

Add a half-pint of asphalt to one quart of red oak stain, a 4:1 ratio if you're mixing larger or smaller quantities. Use scrap from your project to test the stain for color. For a lighter look, add natural stain as a thinner. For a darker color, sparingly add more tar and test frequently. (Natural stain mixed with tar by itself makes a light stain.)

Alan's Mission Formula

Red Oak Stain + Non-fibered roofing tar = Fumed-looking stain

discovered that ammonia fumes, created by farm animal wastes, reacted with the tannic acid found naturally in oak. Stickley used that knowledge to develop an ammonia-fuming process that created a distinctive, consistent tint in quartersawn oak. The downside is that ammonia fuming poses serious health and safety risks.

The challenge today is to create a user-friendly, safe-to-make finish that closely matches the Stickley look using materials readily available at hardware stores.

To meet this challenge, we turned to Alan Noel, a professional finisher in Atlanta. He shared with us his novel stain mix that's easy enough for a hobbyist, yet attractive enough to appeal to professional restorers.

Alan's modern-day match

To make certain his Mission finish matched today's aged original finishes as accurate as possible, Alan borrowed examples of authentic Stickley furniture in their original finishes from his next-door neighbor. "I knew he had collected several pieces of Stickley and had inherited a few others from his father as well. Fortunately, he was happy to help," Alan says.

One discovery was that Stickley furnishings came in a range of shades, from natural to a dark ebonized finish. (See samples of comparable shades at *right*.) Choosing a popular tint for today's furniture, here's how Alan duplicated the medium-light original Stickley finish on an oak chair.

STEP 4
LAY ON A COLOR COATING

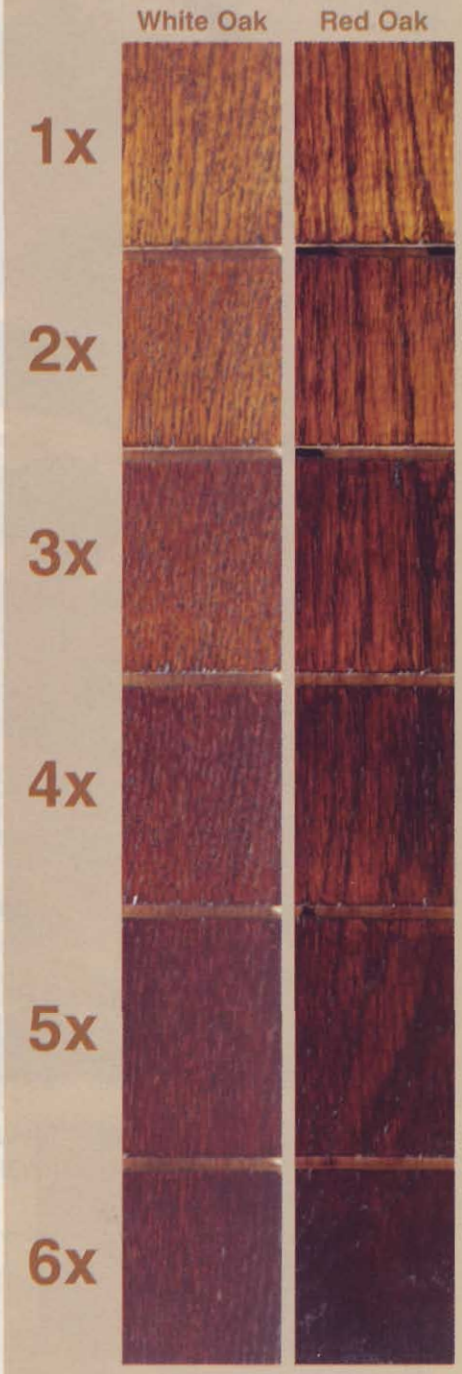
In a well-ventilated space, work the asphalt/stain mix into the grain with a soft brush or rag. Work up from the bottom so that drips or spills on surfaces below will do no harm. Let the stain stand for 3 to 5 minutes, then wipe off the excess. For darker finishes like those shown *far right*, spray on light coats of the mixture without wiping them off.

STEP 5
ADD THE CLEAR FINISH

Let the stain dry completely before spraying additional coats of stain and topcoating. Protect the wood with an oil-based satin varnish—polyurethane in this case—applied using a natural bristle brush or by spraying. After the topcoat dries, rub lightly with 0000 steel wool. A buffed coat of dark wax completes the finish.

Shades of the Past

These sample boards demonstrate the depth of color you can create by layering up to six coats of Alan's stain. He recommends that the first stain application dry for at least 36 hours before you spray on added layers of stain. You'll need a spray gun because brushing on additional stain could reactivate previous coats and muddy the look. A clear topcoat can be brushed over a single stain coat, but must be sprayed on if you applied multiple stain coats.



tilting-bin spice cabinet

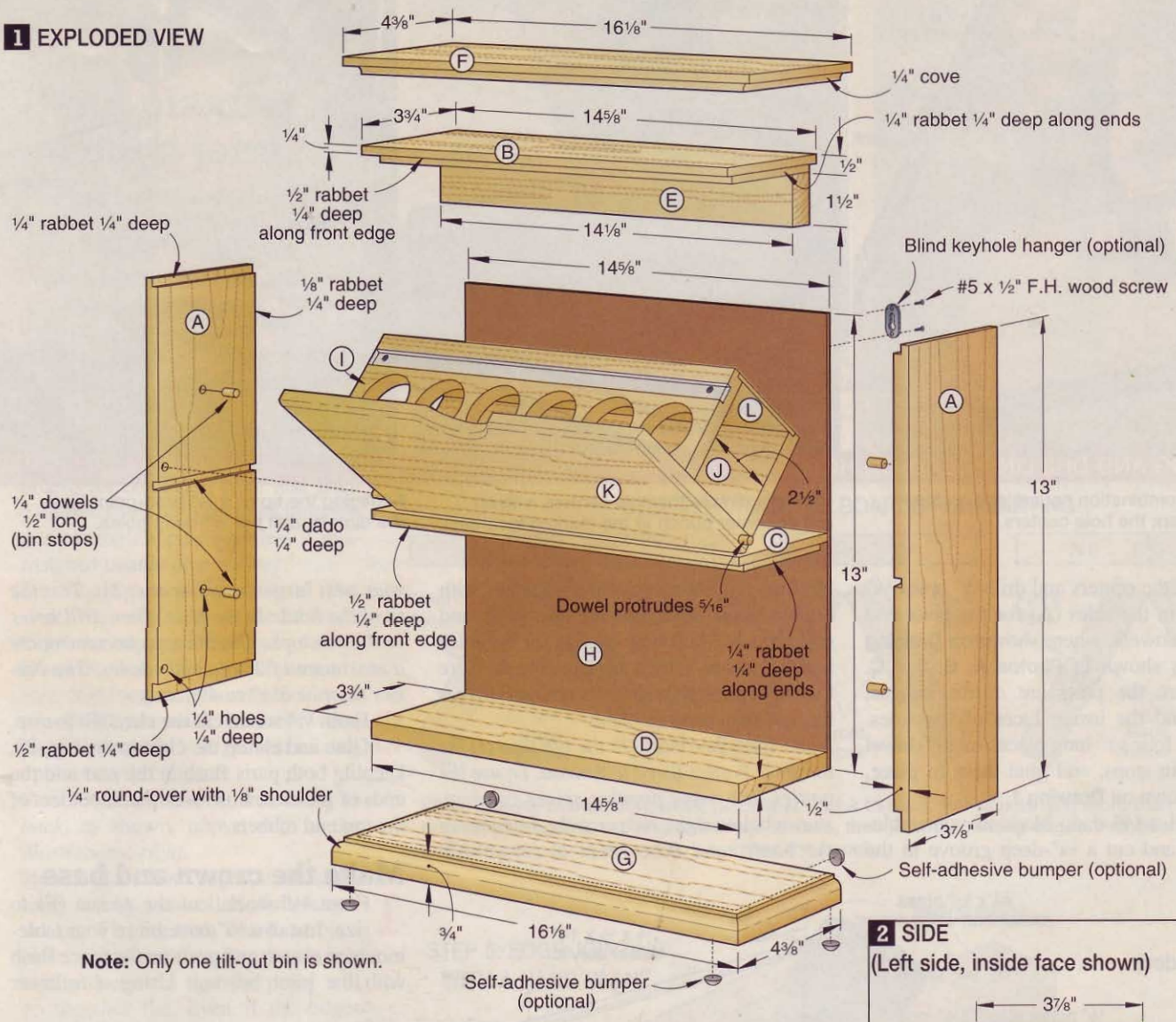
Reduce the jumble in your kitchen cabinets by keeping a dozen of your most used spices at your fingertips, yet out of sight when not being used.

With the bins closed, your spices are neatly tucked away and protected from sunlight, dust, and spatters.

No space on the counter? No problem. This cabinet also can hang on the wall.

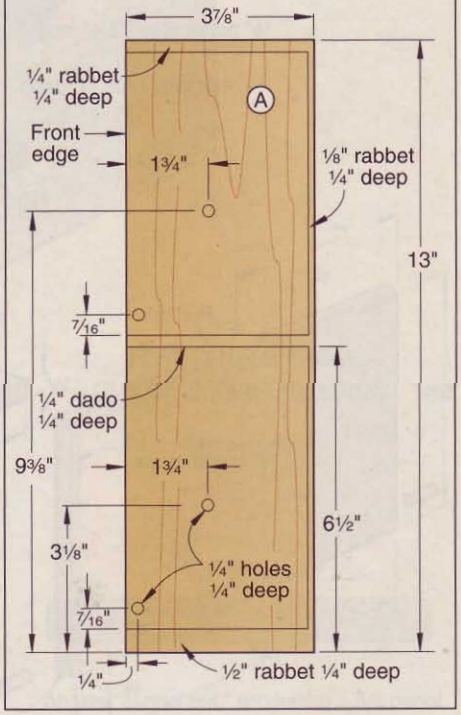
Even if you don't cook, you can be the most popular guy in the kitchen with this weekend project. Designed with expert input from the home economists in the *Better Homes and Gardens®* Test Kitchen, this handsome spice cabinet with tilt-out bins is sure to

1 EXPLODED VIEW



Note: Only one tilt-out bin is shown.

2 SIDE
(Left side, inside face shown)



please the most demanding chef, *and* you can complete it in a weekend. Use your own 3½"- to 4½"-tall spice bottles that fit up to a maximum 2"-diameter hole, or see **Source** to order a matching set of bottles. We even supply labels for 30 different spices you can copy, cut, and paste to identify both the bins and the bottles.

Cut the dadoes and rabbets

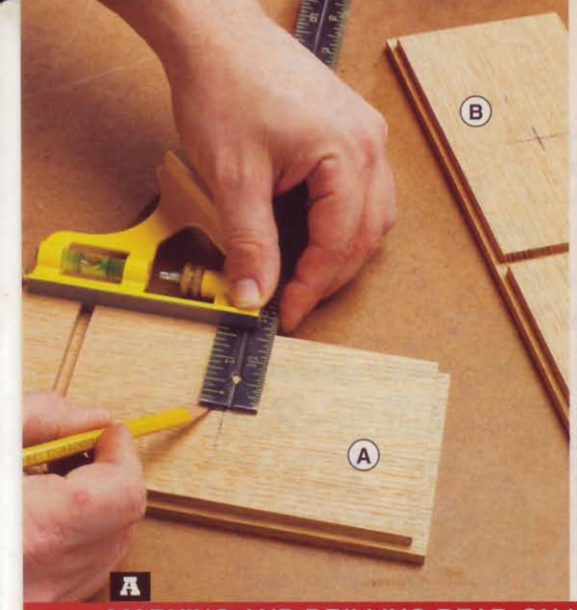
1 From ½" stock, cut the sides (A), top (B), shelf (C), bottom (D), bin tops (I), and bin bottoms (J) to the sizes listed in the **Materials List**. Set the bottom (D) aside.

2 Install a ¼" dado blade in your tablesaw, and attach an auxiliary extension to your miter gauge. Position the fence as a stop, and cut ¼"-deep dadoes in the sides (A), where shown on **Drawings 1** and **2**.

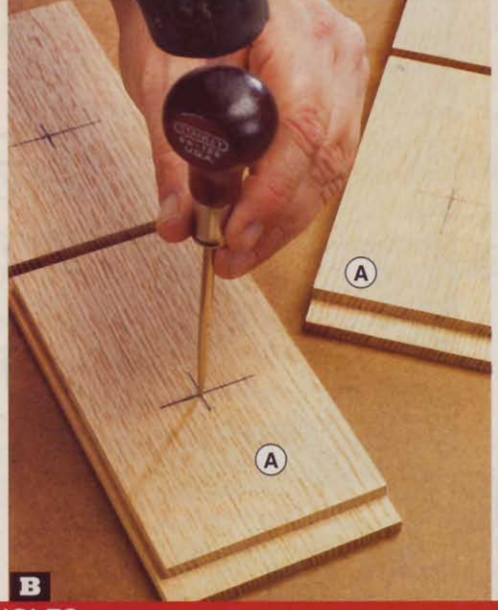
3 Install a ⅝" dado blade in your tablesaw, and attach a ¾"-thick auxiliary fence to the rip fence. Exposing ⅛" of the blade, cut ¼"-deep dadoes along the rear edges of the sides (A), bin tops (I), and bin bottoms (J), where shown on **Drawings 2** and **3**. Make sure the sides are mirror images. To learn how to use an auxiliary fence when cutting rabbets, see the sidebar on *page 53*.

4 Move the fence to expose ¼" of the dado blade. Then to steady the parts and reduce chipping, attach an auxiliary extension to the miter gauge with its end 1/16" from the face of the fence. Now cut ¼"-deep rabbets in the upper ends of the sides (A) and both ends of the top (B) and shelf (C), where shown on **Drawings 1** and **2**.

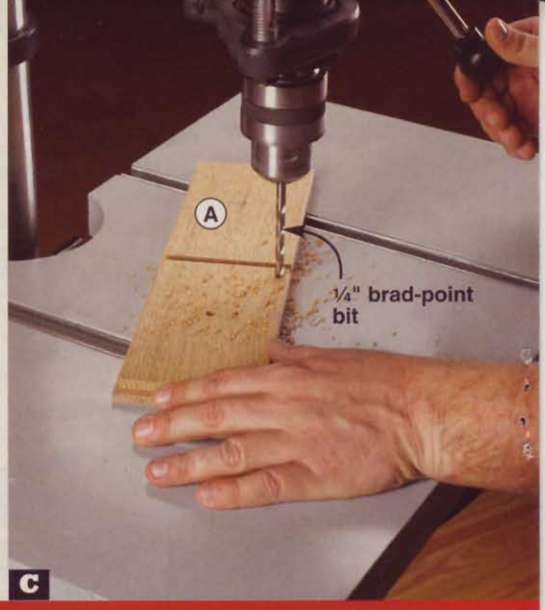
5 Move the fence to expose ½" of the dado blade, and cut ¼"-deep rabbets in the lower ends of the sides (A), where shown on **Drawings 1** and **2**. Then cut the same rabbets along the front edges of the top (B) and shelf (C), where shown on **Drawing 1**.



A



B



C

MARKING AND DRILLING DEAD-ON HOLES

Using a combination square and a *sharp* pencil, mark the hole centers.

Carefully dimple the hole centers with an awl or center punch at the marked locations.

Engaging the tip of a ¼" brad-point bit in the dimple, drill the ¼"-deep holes.

6 Mark the centers and drill ¼" holes ¼" deep in the sides (A) for the pivot and bin stop dowels, where shown on **Drawing 2**, and as shown in **Photos A**, **B**, and **C**. Make sure the parts are mirror images. Finish-sand the inside faces of the sides. Then cut four ½"-long pieces of ¼" dowel for the bin stops, and glue them in place, where shown on **Drawing 1**.

7 Install a ½" dado blade in your tablesaw, and cut a ⅛"-deep groove in the bin tops (I). Then stick them together with double-faced tape, keeping the ends and edges flush. Mark hole centers for the spice bottles, where shown on **Drawing 4**. Bore the holes through both parts with a Forstner bit, and then separate them.

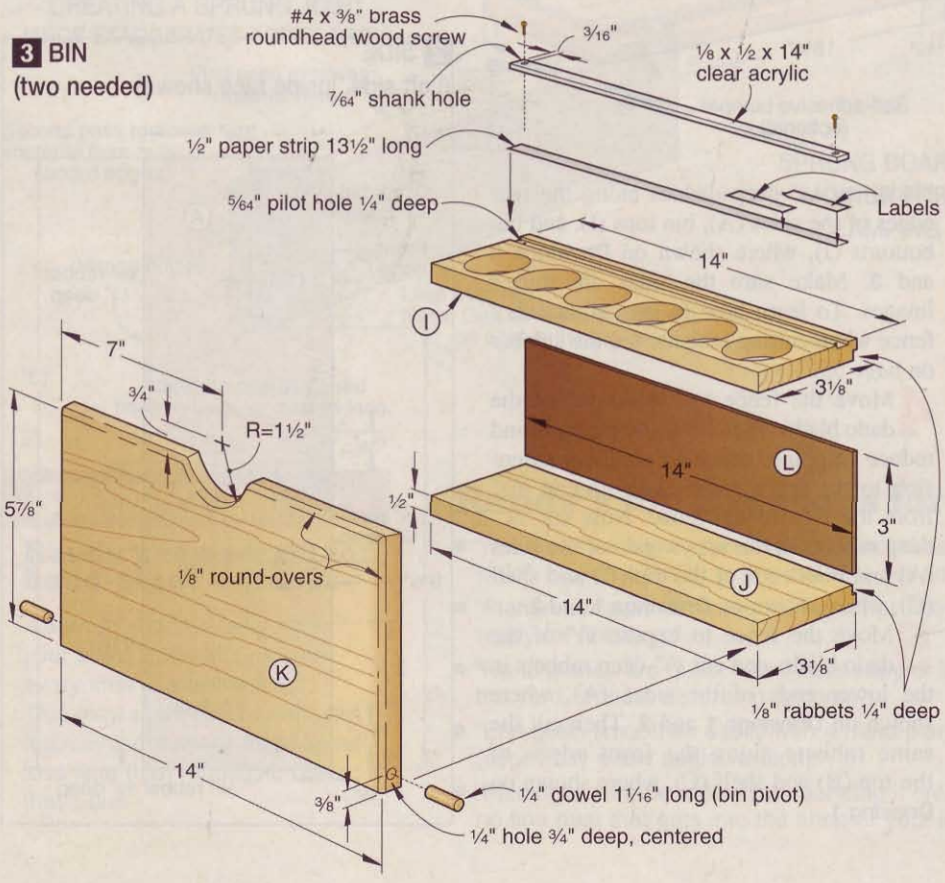
Note: *Bore 1¾" holes in the bin tops (I) for the spice bottles listed in* **Source**. *To use the bottles that many popular spices come in, shown* below right, *measure the diameter of the bottle, and bore holes in scrap with your next larger size Forstner bit. Test the fit of the bottle in the hole. Then drill holes in the bin tops. The bin tops accommodate a maximum of 2"-diameter holes. The bottles must be 3½" to 4½" tall.*

8 From ½" stock, cut the cleat (E) to size. Glue and clamp the cleat to the top (B), keeping both parts flush at the rear and the ends of the cleat flush with the shoulders of the top end rabbets.

Make the crown and base

1 From ½" stock, cut the crown (F) to size. Install a ¼" cove bit in your table-mounted router, and position the fence flush with the pilot bearing. Using a follower

3 BIN
(two needed)



YOU CAN USE THESE OFF-THE-SHELF BOTTLES TOO

Measuring a selection of spice bottles from a supermarket yields the hole sizes shown.

1⅞" holes

2" holes

block to steady the part and reduce chip-out, rout coves in the ends of the crown and then along its front edge, where shown on **Drawing 1**.

2 From ¾" stock, cut the base (G) to size. Install a ¼" round-over bit in your table-mounted router. Again using a follower block to back the end cuts, rout round-overs with ⅛" shoulders on the ends and along the front edge of the base, where shown on **Drawing 1**.

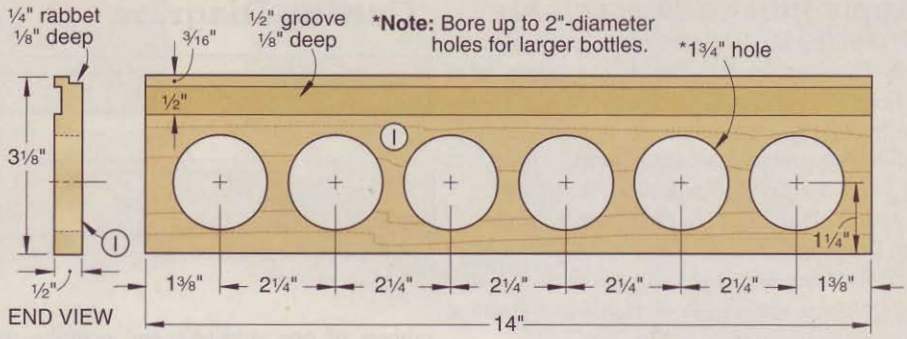
Assemble the bins

1 From ½" stock, cut the bin fronts (K) to size. Draw the cutouts in the top edges of the bin fronts, where shown on **Drawing 3**, and bandsaw and sand them to shape. Then install a ⅛" round-over bit in your table-mounted router, and rout their outside ends and edges.

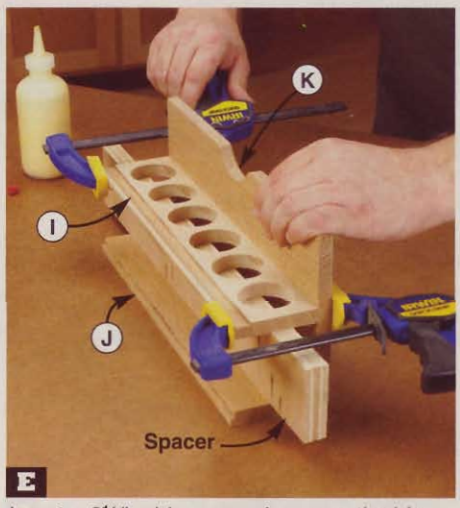
2 Drill ¼" holes ¾" deep, centered in the edges of the bin fronts (K), where shown on **Drawing 3** and as shown in **Photo D**. Then cut four 1¼"-long pieces of ¼" dowel for the bin pivots, and glue them in the holes. Using a 5/16"-thick spacer to guide a fine-tooth saw, trim the dowels, leaving 5/16" protruding.

3 Glue and clamp the bin bottoms (J) to the bin fronts (K), keeping both parts flush at the ends and lower edges, where shown on **Drawing 1**. Let the glue dry. Then glue and clamp the bin tops (I) to the bin fronts, as shown in **Photo E**.

4 BIN TOP



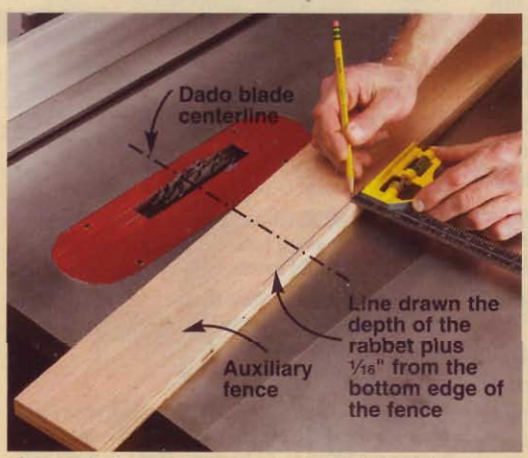
Using a doweling jig to center the drill bit on the thickness of the bin fronts (K), drill ¼" holes ¾" deep ⅜" from the bottom edges for the bin pivot dowels.



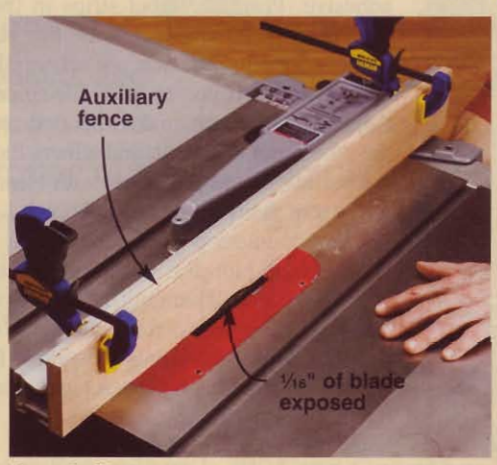
Insert a 2½"-wide spacer between the bin bottom (J) and bin top (I), and glue and clamp the bin top to the bin front (K), keeping the ends flush

Cut right-on rabbets the quick and safe way

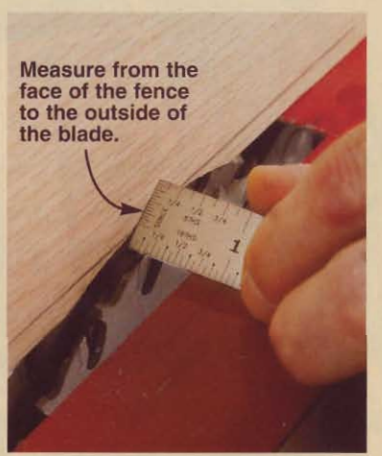
When faced with cutting rabbets of the same depth but several widths, as in this project, save time and increase accuracy by installing a dado blade that accommodates the widest rabbet and using an auxiliary fence with your tablesaw rip fence.



Step 1: Install a dado blade about ⅛" wider than the widest rabbet you'll be cutting. Then cut a piece of softwood, plywood, particleboard, or medium-density fiberboard that's at least ⅛" thicker than the dado blade to the same size as the face of your tablesaw rip fence. Mark the depth of the rabbets you will cut plus 1/16" for clearance on the auxiliary fence with a line parallel to the bottom edge and centered on the blade.



Step 2: Clamp the auxiliary fence to the rip fence. Make sure the clamps will not interfere with the workpiece. With the dado insert in place and the dado blade below the surface of the table, position the auxiliary fence over the blade so about 1/16" of the blade will protrude beyond its face. Lock the fence in place, switch on the saw, and slowly raise the blade into the auxiliary fence to the depth line.



Step 3: Switch off the saw. Lower the blade slightly, reposition the fence to expose the width of dado blade required for the first rabbet, and make a test cut. Make any adjustments needed, and rabbet your parts. Then, repositioning the fence to expose the width of blade necessary, rabbet the other parts.

Apply finish and assemble

1 Finish-sand all parts and assemblies. Then apply the finish, as shown in **Photo F**. (We used Zar Salem Maple stain followed by three coats of aerosol semi-gloss polyurethane, sanding between coats.)

2 Cut the bin backs (L) to size, and glue and clamp them in place, where shown on **Drawing 3**.

3 Working with the front edges on a flat surface, spread glue in the dado and end rabbets of one side (A), and position the ends of the top/cleat assembly (B/E) and bottom (D) in the rabbets and the shelf (C) in the dado. Then position the two bin assemblies (I/J/K/L) facedown with the pivot dowels in the holes in the side. Now spread glue in the dado and end rabbets of the other side, and add it to the assembly, as shown in **Photo G**. Glue and clamp the assembly, and check it for square.

4 Cut the back (H) to size, and glue and clamp it in place. Then glue and clamp the crown (F) and base (G) to the case, flush at the rear, and centered side-to-side.

5 Cut two ½×14" strips of ⅛" acrylic, and drill centered screw holes in the ends, where dimensioned on **Drawing 3**. Position the strips in the bin top (I) dadoes, and using the holes in the strips as guides, drill pilot holes into the bin tops.

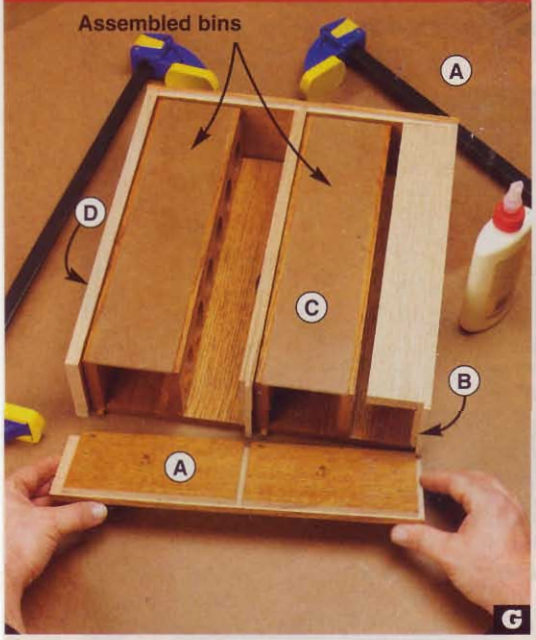
6 Using a straightedge and utility knife, cut two ½×13½" strips from white paper. Then make a copy of the labels on *page 105*. (We copied ours onto ivory-color paper.) Now cut out the 12 labels you need. Arrange the labels in alphabetic order, and adhere them to the paper strips with spray adhesive. Place the label strips in the bin top dadoes, cover them with the acrylic strips, and drive the screws, where shown on **Drawing 3**. If you're using the spice bottles listed in **Source**, make a second copy of the labels, cut them out, and adhere them to the bottles. Cover the labels with clear tape to prevent them from getting soiled.

7 For countertop use, adhere four self-adhesive bumpers to the bottom of the base (G). For wall hanging, adhere two self-adhesive bumpers to the rear edge of the base. Then position a pair of keyhole hangers 1½" in from each side (A) and centered on the width of the cleat (E). Drill pilot holes and screw the hangers in place. Next install screw anchors in the wall to align with the hangers, and drive #8×1½" flathead wood screws, letting the screw heads protrude ⅛". Position the spice rack with the hangers over the screwheads and slide the rack onto them. Fill the bins, and start spicing up your kitchen.

APPLY FINISH BEFORE ASSEMBLY

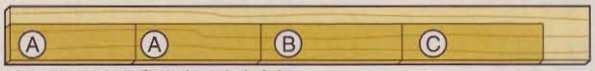
Covering the mating glue surfaces with masking tape, apply stain and then a clear finish to all the parts and assemblies. When the finish dries, remove the tape.

ASSEMBLE THE CASE

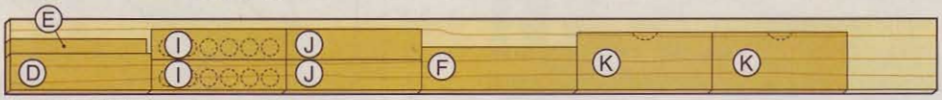


With glue spread in its dado and end rabbets, tip the second side (A) into place, simultaneously engaging the top (B), shelf (C), bottom (D), and the bin pivot dowels.

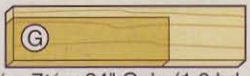
Cutting Diagram



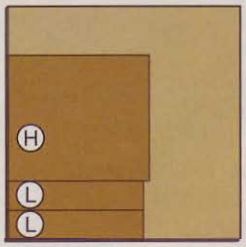
½ x 5½ x 60" Oak (1.3 bd. ft.)



½ x 7¼ x 96" Oak (2.6 bd. ft.)



¾ x 7¼ x 24" Oak (1.3 bd. ft.)



⅛ x 24 x 24" Tempered hardboard

Materials List

Case	FINISHED SIZE T	W	L	Matl.	Qty.
A sides	½"	3⅞"	13"	O	2
B top	½"	3¾"	14⅝"	O	1
C shelf	½"	3¾"	14⅝"	O	1
D bottom	½"	3¾"	14⅝"	O	1
E cleat	½"	1½"	14⅛"	O	1
F crown	½"	4⅜"	16⅛"	O	1
G base	¾"	4⅜"	16⅛"	O	1
H back	⅛"	13"	14⅝"	H	1
Bins					
I bin tops	½"	3⅛"	14"	O	2
J bin bottoms	½"	3⅛"	14"	O	2
K bin fronts	½"	5⅞"	14"	O	2
L bin backs	⅛"	3"	14"	H	2

Materials key: O–oak, H–tempered hardboard.

Supplies: ¼" dowel, double-faced tape, masking tape, ⅛" clear acrylic, #4×⅜" brass roundhead wood screws, #5×½" flathead wood screws, spray adhesive, clear tape.

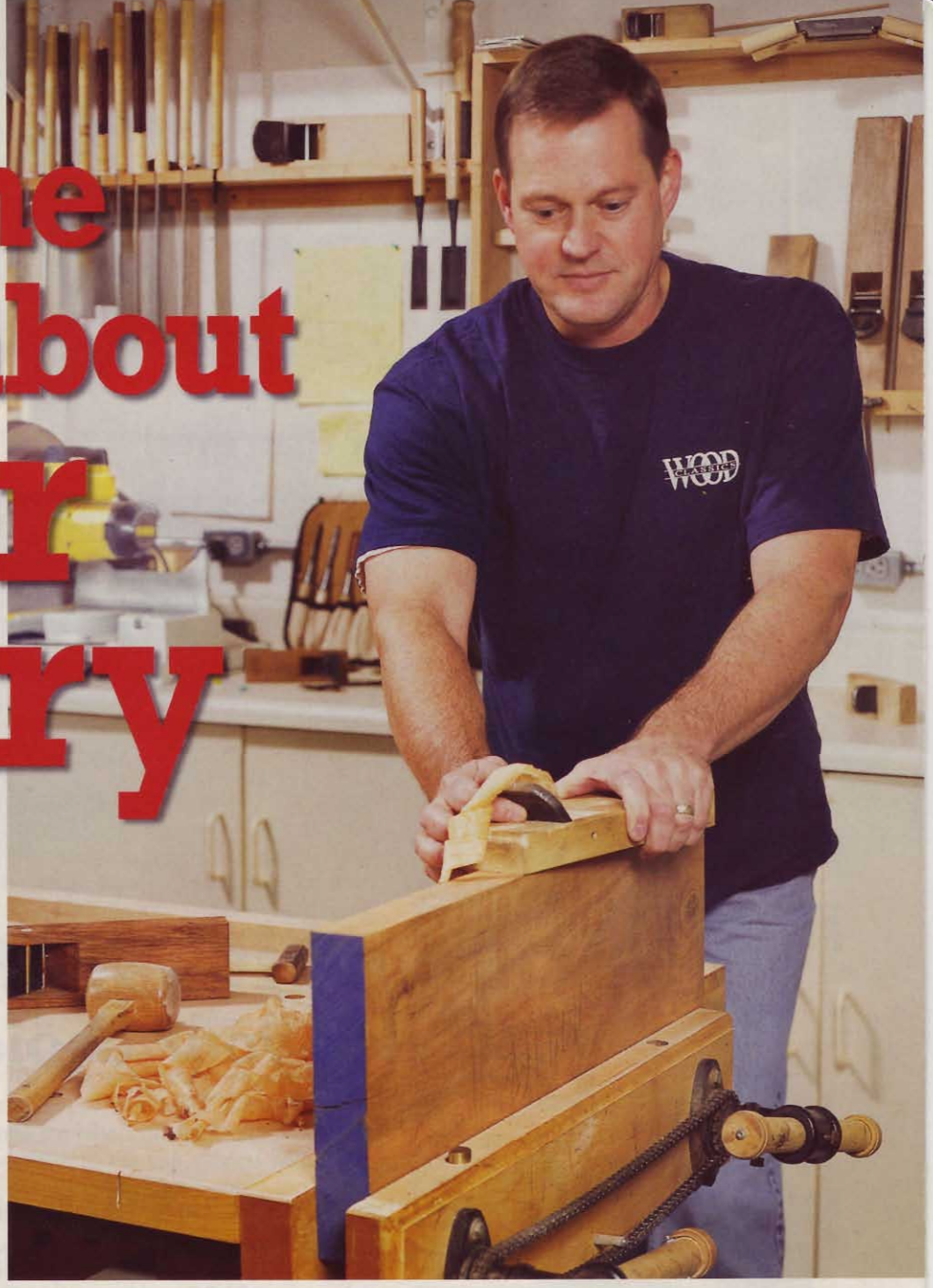
Blades and bits: Stack dado set; 1¾" Forstner bit (or up to 2" to fit your spice bottles); ¼" cove, ⅛" round-over, and ¼" round-over router bits.

Source

Hardware. Glass spice bottles with plastic spoon-or-shake lids no. 12K82.01, $.90 ea. (12); blind keyhole hangers no. 00S10.11, $2.30 (package of 10); 10mm self-adhesive bumpers no. 00S20.02, $4.80 (package of 43). Call Lee Valley 800/871-8158, or go to leevalley.com.

Written by **Jan Svec**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine**

the plane truth about better joinery



Learn one craftsman's secrets for creating **3** high quality joints using hand planes.

LEARN FROM A MASTER

A seasoned, award-winning woodworker, Randy Miller has a shop brimming with power tools yet makes no bones about his love and use of hand planes. "They give me better quality without increased effort," he says.

In a recent visit to his workshop in Aliso Viejo, California, Randy walked us through his techniques for hand-planing edge joints and miters that fit better, he says, than anything you can produce with a machine. Randy also introduced us to the Japanese planes he favors because of the increased control he believes they offer. Of course, Randy's techniques will work equally well with Western-style planes too.

Using a small bronze-headed mallet—the only adjustment tool required—Randy Miller gently taps the iron on his Japanese smoothing plane to expose more of the cutting edge and take a deeper cut.

Randy built this seven-drawer chest using hand tools. He planed the drawers to fit perfectly in the openings and to slide with ease.

Joint 1:

Hand planing an edge joint

Most of us flatten and square board edges with a jointer. Randy chooses not to have a jointer in his shop because the tool's rotating head cuts the edge in little scallops. Instead, he uses a hand plane to create a smooth, flat edge that will later yield an almost invisible joint. Here's how he does it:

Step 1. To make a hand-jointed panel, start by carefully matching boards for consistent color and grain patterns. Even with these techniques, a joint won't appear seamless if mismatched boards give it away.

Step 2. Rip each board about 1/16" wider than necessary at the tablesaw to get the edges parallel and relatively square to the face of each board.

Step 3. Arrange the boards to form a panel, and then mark the face with a large carpenter's V to prevent mixing up the board sequence.

Step 4. Clamp the boards *back to back*, as shown, *above*, and in the illustrations, *right*.

Step 5. Plane both edges at the same time using controlled full-length strokes. Planing both boards at once offers a wider surface for the plane's sole and ensures that the panel will go together flat, even if the edges are out of square, as shown in the drawings, *right*.

Note: *Because you may not be able to plane with the grain on both boards, use a well-sharpened plane iron set for a very light cut to prevent grain tear-out.*

Hold the plane's sole flat on the board edges and work the entire length of the boards, as shown in the photo, *top right*.

Note: *Randy chose a long version of a "Hira Kana" or smoothing plane about 18" long for jointing these 36"-long boards. If you use Western-style planes, choose a Jack plane or a #5 bench plane.*

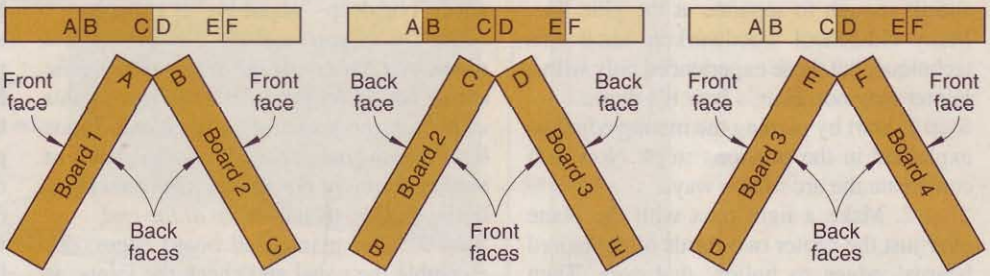
Step 6. After jointing the boards, check the fit of the joint. If necessary, plane the boards further until the edges mate seamlessly along the entire length of the joint.

PLANING IN PAIRS YIELDS A PERFECT JOINT

Align boards with their mating edges flush. A large bench vise holds the boards best, but any clamps that can secure the boards will do.

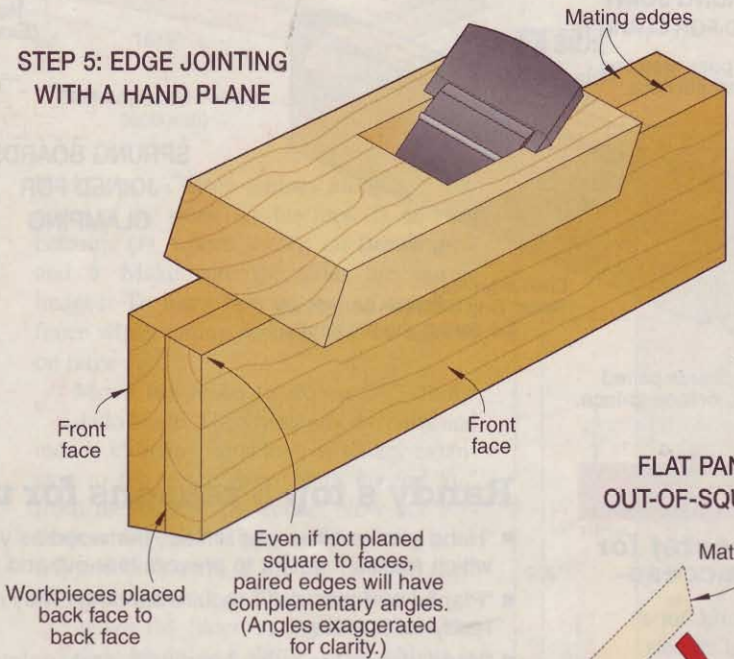
Make passes with the plane over the full length of the boards. Keep the sole flat, and plane until you peel off two full-width shavings.

STEP 4: PAIRING THE BOARDS FOR JOINTING

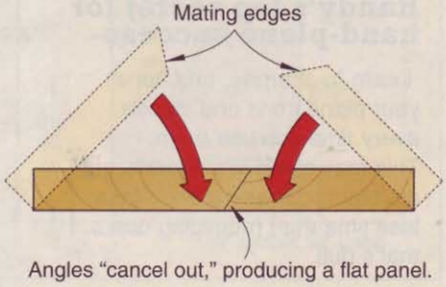


When planing two-board panels, place them back to back. For panels with more than two boards, pair boards two and three *face-to-face*, then joint the mating edges. Pair boards three and four *back-to-back*, and so on across the panel.

STEP 5: EDGE JOINTING WITH A HAND PLANE


Mating edges
Front face
Front face
Workpieces placed back face to back face
Even if not planed square to faces, paired edges will have complementary angles. (Angles exaggerated for clarity.)

FLAT PANELS FROM OUT-OF-SQUARE BOARDS



Joint 2:

The sprung joint

After practicing Randy's methods, you'll be able to create panels with almost invisible seams. While this might seem like the perfect joint, Randy thinks it can be improved by—get this—creating a gap between the boards. This technique, called a sprung joint, produces a shallow concave arc in each adjoining edge.

Why? A board absorbs and sheds moisture most easily through its ends, so those ends may change in width more than the middle of the board. The sprung joint leaves the ends of each board a hair wider, allowing them more movement before they might shrink enough to separate at the glue line. Many old-school woodworkers know this technique, but those experienced only with a jointer may not. Here's how it's done:

Step 1. Start by planing the mating edges as explained in the previous steps. Now you can create the arc in two ways.

Step 2. Make a light pass with the plane over just the center two-thirds of the paired boards' edges to hollow that area, Then make a full-length pass or two to create a smooth arc, as shown, *below left*. The arc needn't be deep—about 1/32" is enough.

Note: *Once you master control of the plane, you can create the arc by planing the entire board length in one or two passes while varying pressure on the plane. Place light downward pressure on the plane at the beginning of the stroke, heavy pressure in the middle, then ease up at the end.*

Step 3. After planing all board edges, dry assemble the panel and check the joints, as shown, *below right*.

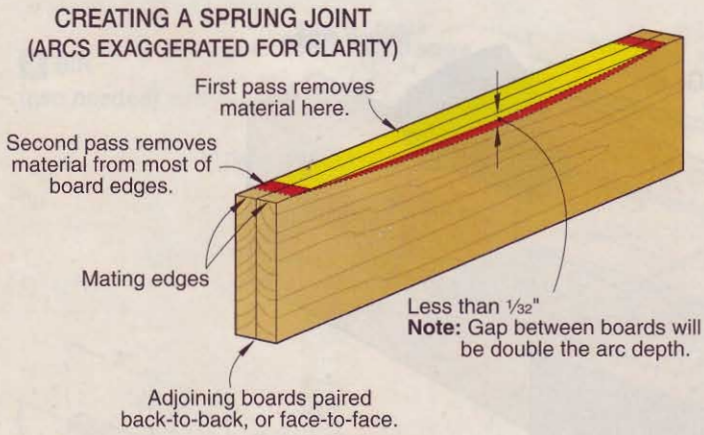
Step 4. Tighten the clamps to make sure all gaps close fully along mating edges as shown, *above right*. Fine tune any joints, if necessary, by planing them again following **Steps 1** and **2**.

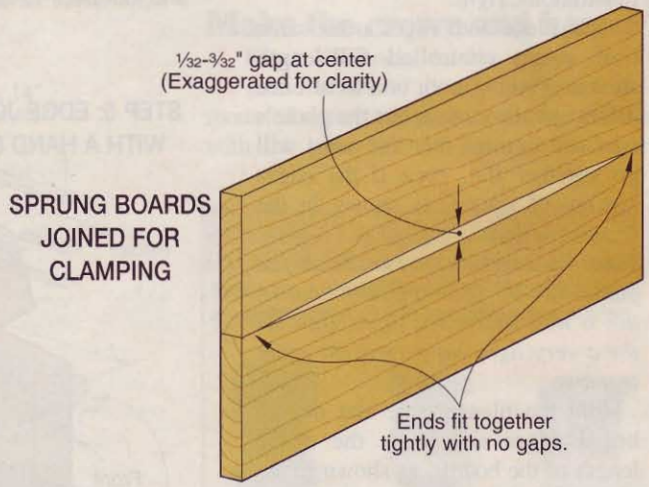
Step 5. Now glue up the panel. To ensure good quality joints, either tighten the clamps working from one end toward the other, or tighten center clamps first and work outward toward each end. To ensure a flat panel, make sure the boards don't slip out of alignment as you tighten the clamps.

NOW YOU SEE IT, NOW YOU DON'T

When ready to be joined, mating boards should fit together tightly at the ends and be separated by about 1/32" to 3/32" in the middle.

Tightening the clamps pulls the joint tight, leaving no trace of the gap. The technique also helps evenly spread the clamping force.


CREATING A SPRUNG JOINT
(ARCS EXAGGERATED FOR CLARITY)
First pass removes material here.
Second pass removes material from most of board edges.
Mating edges
Less than 1/32"
Note: Gap between boards will be double the arc depth.
Adjoining boards paired back-to-back, or face-to-face.



SHOP TIP

Randy's top secret for hand-plane success

Learn to sharpen, and hone your plane irons and chisels every time you use them. This may seem like overkill, but maintaining a sharp edge takes less time than rebuilding one that's dull.

Randy's top 5 reasons for using hand planes

- "Hand planes allow you to 'feel' the wood as you cut, which makes it easier to prevent tear-out and other problems."
- "Planed surfaces don't require sanding. They're smooth and ready for finishing."
- "Hand planes are quiet. I can work early or late, even out in the yard, without disturbing anyone."
- "End grain smoothes easily with a hand plane (especially a low angle version)."
- "Planing a surface rather than sanding it creates no fine dust that gets into the shop or your lungs."

Randy's award-winning upright cabinet proves his hand-plane techniques work.

Joint 3:

Shooting for a marvelous miter

Hand-planes work equally well when making mitered boxes. Here, Randy relies on a simple 45° shooting board to guide his plane at the precise angle. A block plane will shave the miters effectively, but Randy often uses the same smoothing plane he employs for jointing. Here's what to do:

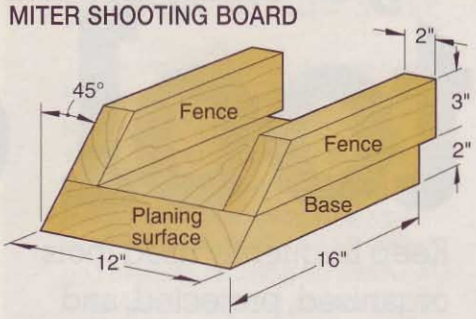
Step 1. Rip the box sides to width, and then miter them at the tablesaw to a length about 1/32" longer than necessary.

Step 2. Dry clamp the box sides together and check the fit of all miters, *below left*. If a gap exists at any corner, remove those two mating boards from the clamps.

Step 3. Place one of the two box sides on a shooting board, like the one shown at *right*, and make a couple of passes (removing *very* thin shavings) over the appropriate end, as seen, *below center*. Hold the board firmly against the shooting board. Repeat this for the mating board.

Step 4. Place the boards back in the clamps and recheck the fit, as shown, *below right*. If the miter is tight and the corner square, move to the next corner. Check each corner and repeat **Steps 3** and **4** as needed as you work around the entire box.

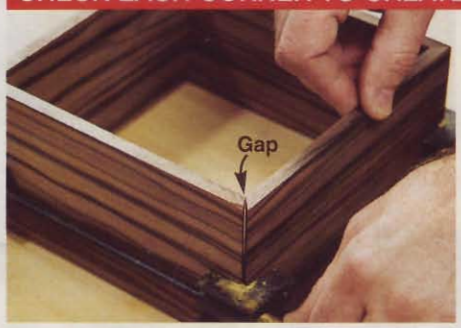
MITER SHOOTING BOARD



Once the sides fit together perfectly, Randy marks the joints clearly before taking the box apart again. Then he cuts the box top and bottom to fit, usually fitting them in grooves cut into the box sides. He assembles the box, then cuts the lid free.

Written by **David Stone** Photographs: **Ed Gohlich**

CHECK EACH CORNER TO CREATE TIGHTER MITERS



Step 2: Randy assembles mitered boxes using a picture-framing clamp. After checking the squareness of one corner, he begins fine tuning the joint with the largest gap.

Step 3: Randy's shooting board consists of a piece of 8/4 oak with side fences. One end is cut at 45°. Placing paper shims under the workpiece allows fine angle adjustment.

Step 4: After planing at the shooting board, recheck the joint. With just a few plane strokes, the joint fits tightly from top to bottom and creates a square corner.

Planing on the pull stroke: A quick look at Japanese planes

Japanese planes differ from Western planes in several important ways.

First, they feature simple wooden bodies made of tight-grained Japanese oak.

Second, the blades simply wedge into the plane body. A chip breaker holds the iron in place and breaks the shavings removed by the blade to prevent tear-out. The chip breaker wedges against a pin that holds it and the iron in position.

Third, no mechanical devices are used to adjust the plane iron. Tapping the blade or plane body moves the iron. "Learning to adjust these planes takes a little time, but the process goes fast when you know how," Randy says.

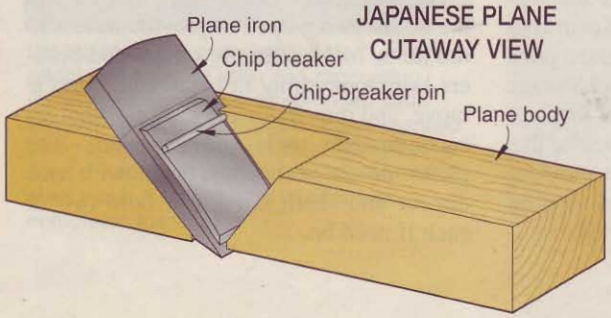
Fourth, the planes are designed to be pulled, rather than pushed. "Pulling the plane gives better control than pushing," Randy says. "Once you get used to doing it, pulling the plane feels natural, even for devotees of Western planes," he adds.

Even the irons, *far right*, are unique in Japanese planes. They consist of a hard steel portion (about 1/8" thick) that's "welded," through hand-forging, to a soft steel backer that makes up the remaining thickness. The hard steel holds an edge well, while the softer steel hones away easily during sharpening and provides some cushion to reduce blade chatter.

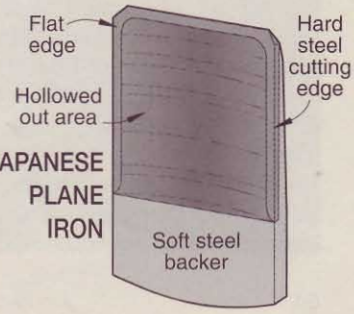
To make sharpening easier, the face of the hard steel is hollowed out, leaving just an edge that requires flattening. After multiple sharpenings, the flat edge gets worn away. When this happens, the blades can be "pounded out" by tapping them near the top of the bevel to flatten part of the hollow area.

If you're looking for Japanese planes, try The Japan Woodworker (japanwoodworker.com; 800/537-7820) or Hida Tool and Hardware Co. (hidatool.com; 800/443-5512). You'll find models priced from $50 up to hundreds of dollars. To learn more about these tools, read *Japanese Woodworking Tools: Their Tradition, Spirit, and Use*, by Toshio Odate, available from Amazon.com.

JAPANESE PLANE CUTAWAY VIEW



JAPANESE PLANE IRON



go-anywhere tool caddy

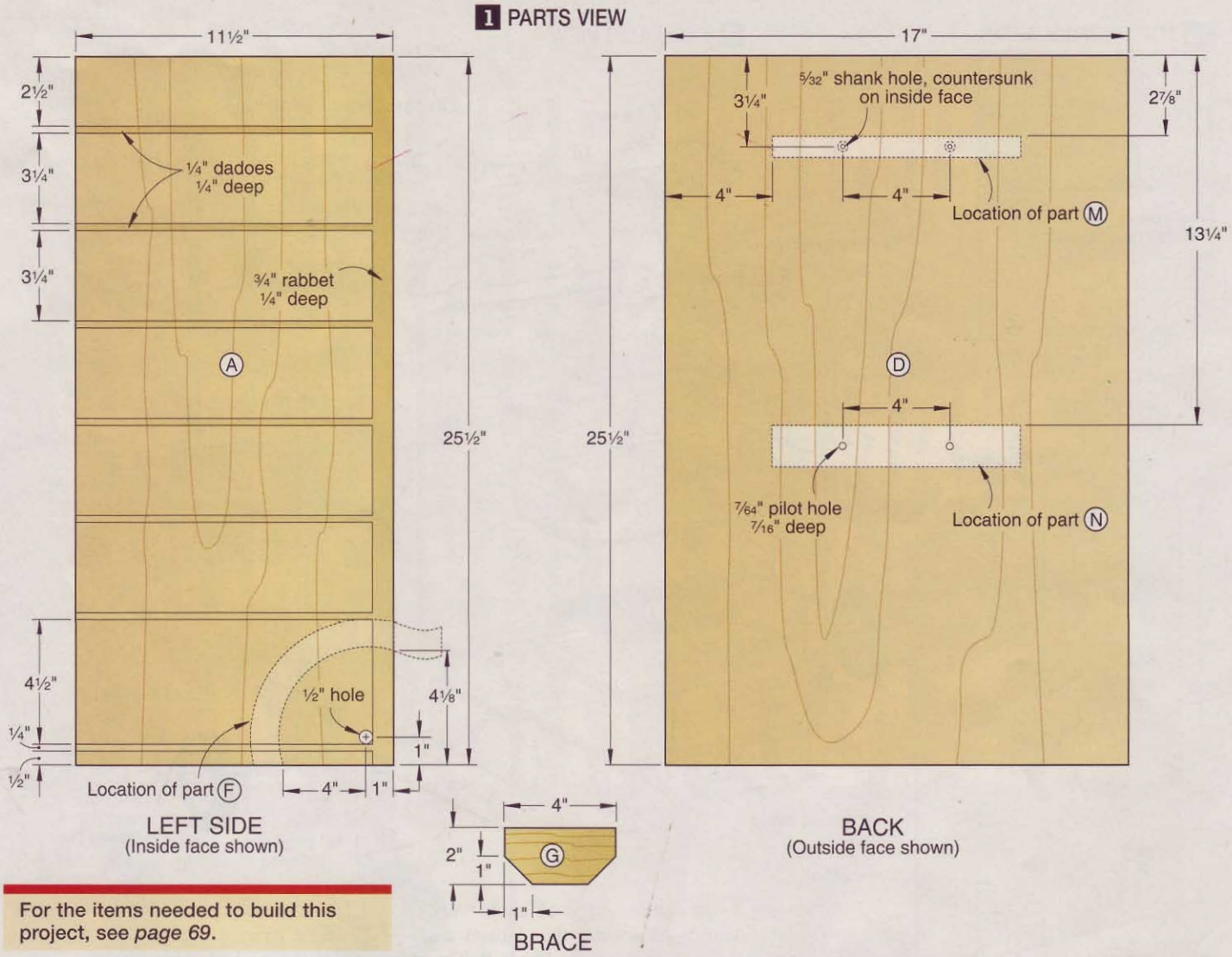
Keep frequently used tools organized, protected, and within easy reach wherever you go by rolling this compact cart right up to your work area. Its drawers, shelves, top tray and doors create numerous storage opportunities.

Thanks to its large 6"-diameter wheels and easy-adjust, fully retractable, locking handle, moving the caddy is a cinch.

Here it is—our version of the tag-along tool tote that won Kevin Hall of Tremonton, Utah, the grand prize in our 2004 "Rugged 'n' Ready Tool Storage Contest." Kevin's inspiration for the unit came from a rolling carry-on suitcase, like those used by airline travelers. It provides on-the-go storage for the tools and supplies you need for fix-ups outside the shop.

The top of the tool caddy flips up and the doors swing open to provide access to the items inside. Simple scrapwood holders keep everything in place while on the move, and removable drawers and shelves accommodate tools and hardware. The photo *above* shows the unit with one drawer and shelf, but it can hold two of each if need be.

Note: *For a natural wood look and void-free edges, we used Baltic birch plywood for our tool caddy, and applied a clear finish. As a less expensive alternative, you can use type AC or BC plywood, particularly if you plan to paint the unit. Also, because the thickness of plywood varies, you may need to slightly adjust the size of some parts and the mating dadoes and rabbets.*



For the items needed to build this project, see *page 69*.

Start with the case

1 Cut the sides (A), axle supports (B), fixed shelves (C), and back (D) to the sizes listed in the **Materials List.**

2 Using a dado blade in your tablesaw, cut seven ¼" dadoes ¼" deep across the width of the sides (A) and a ¾" rabbet ¼" deep along the back edge, where dimensioned on **Drawing 1**. Make sure they are mirror-image parts. Then, drill a ½" hole for the wheel axle through the sides, where dimensioned.

3 Bandsaw a ½×½" notch for the axle in a corner of the axle supports (B), where shown on **Drawing 2**. Then glue and clamp the supports to the sides (A), where shown, with the notches aligned with the ½" holes in the sides.

4 Using your tablesaw, cut ¼" rabbets ½" deep along the ends of the fixed shelves (C), leaving ¼×¼" tongues to fit the dadoes in the sides (A).

5 Cut the top divider (E) to size, making sure the length matches the shoulder-to-shoulder length of the shelves so the case will assemble correctly. Then, with the rabbeted edges of the top fixed shelf facing up, glue and clamp the top divider to it ¾" back from the front edge, where shown on **Drawing 2**. After the glue dries, assemble the case, as shown in **Photo A**.

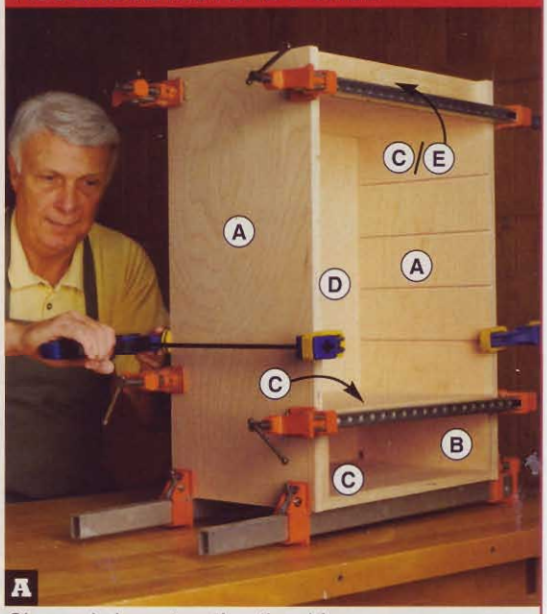
Add the fenders and brace

1 To make the fenders (F), first cut four pieces of ¾" plywood to 5¼×7". Laminate the pieces together to form two 1½"-thick workpieces.

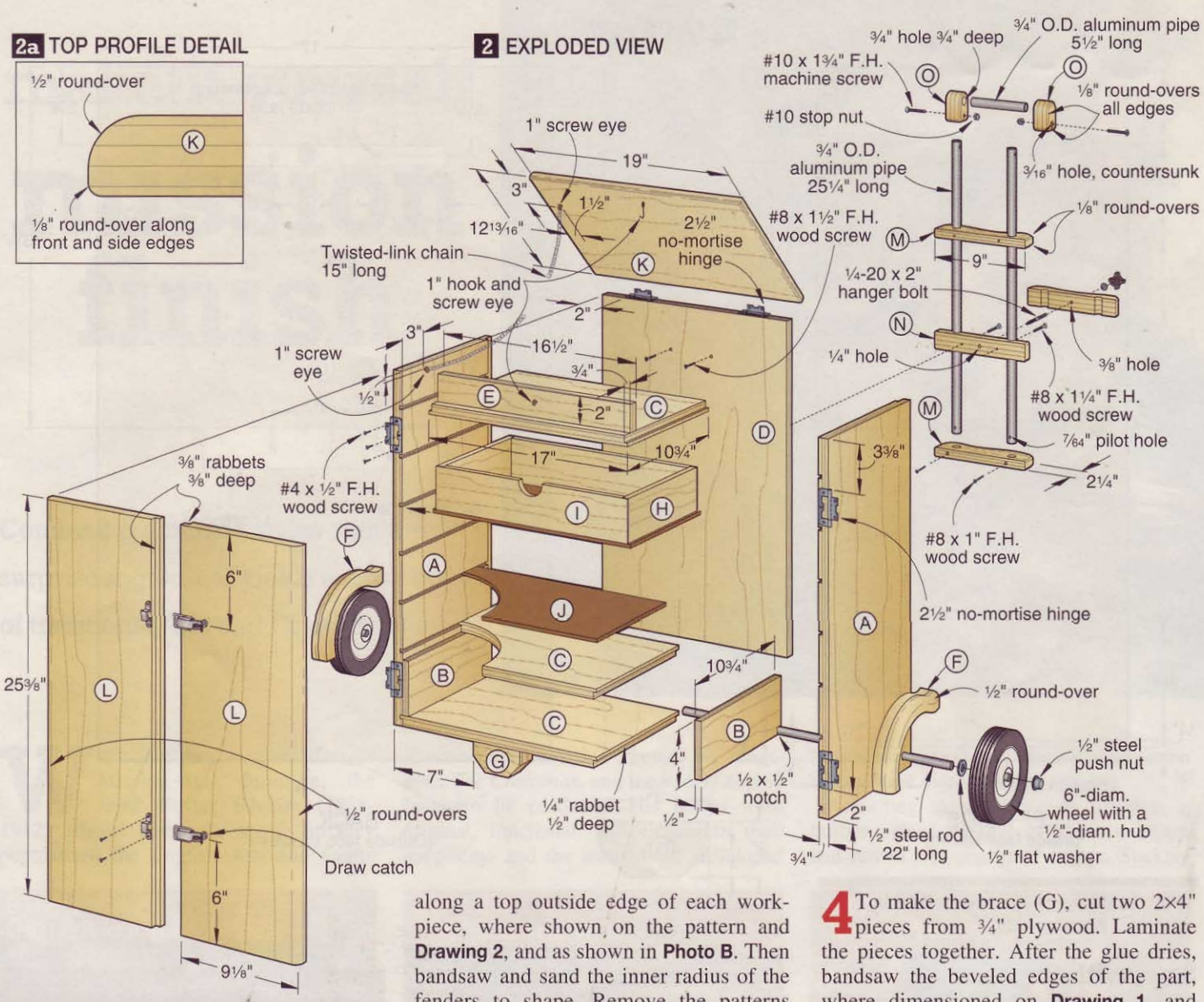
2 Make two copies each of the full-size fender and handle support patterns and three copies of the pipe supports/pipe clamp pattern on the *WOOD Patterns*® insert. Set the handle support and pipe supports/pipe clamp patterns aside. Spray-adhere the fender patterns to the workpieces. Then bandsaw just outside the outer radius on the patterns. Now sand to the line using a 100-grit sanding drum.

3 Noting that the two fenders are mirror images of one another, use your table-mounted router and rout a ½" round-over

ASSEMBLE A STURDY CASE



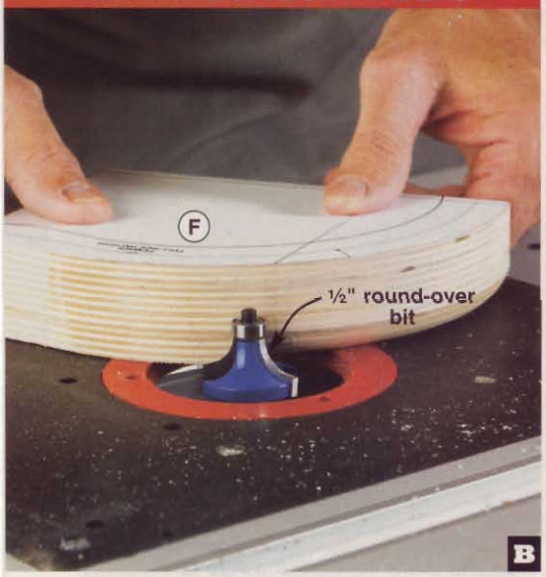
Glue and clamp together the side assemblies (A/B), fixed shelves (C, C/E), and back (D). Make sure the rabbeted edges of shelves C face down and shelf C/E face up.



along a top outside edge of each workpiece, where shown on the pattern and **Drawing 2**, and as shown in **Photo B**. Then bandsaw and sand the inner radius of the fenders to shape. Remove the patterns using a solvent, such as lacquer thinner. Now glue and clamp the fenders to the sides (A), positioning them where dimensioned on **Drawing 1**.

4 To make the brace (G), cut two 2×4" pieces from ¾" plywood. Laminate the pieces together. After the glue dries, bandsaw the beveled edges of the part, where dimensioned on **Drawing 1**, and sand smooth. Now glue and clamp the brace to the bottom fixed shelf (C) centered and flush with the front edge, where shown on **Drawing 2**.

ROUT THE STYLISH FENDERS

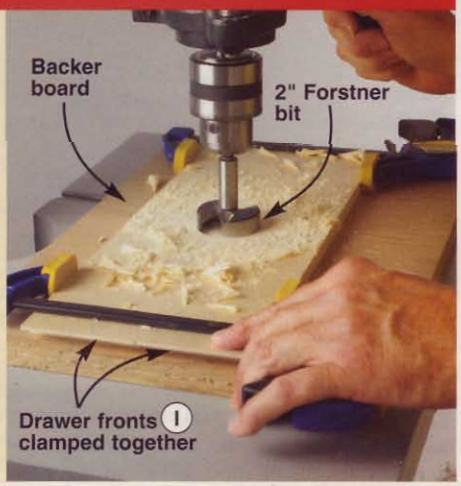


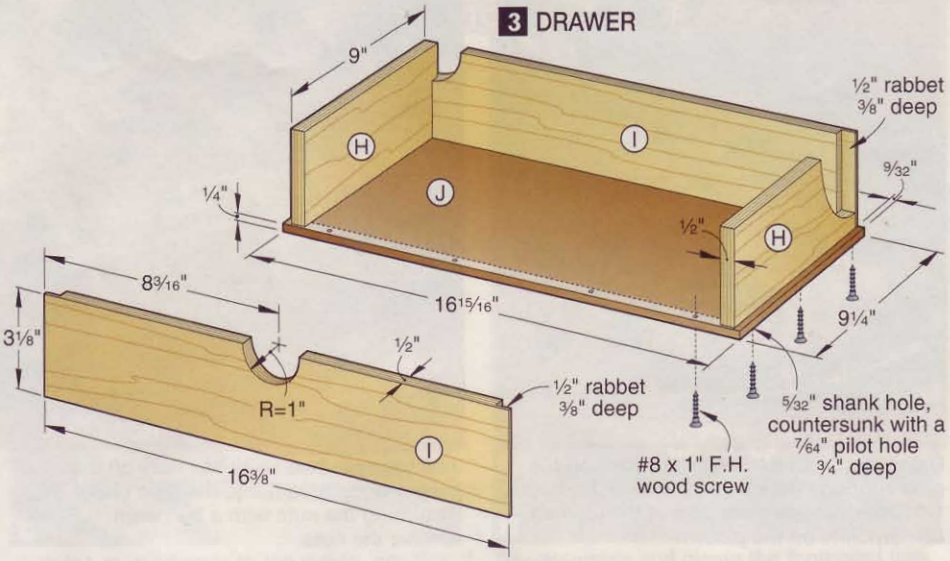
Round over a radiused edge of each fender, routing opposite top outside edges of the pieces to produce mirror-image parts.

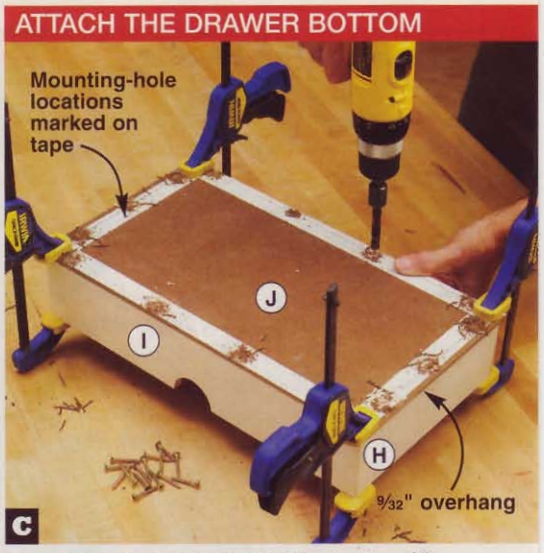
SHOP TIP

An easy (and doubly fast) way to form drawer-pull openings

Here's how to quickly and simultaneously bore precise radiused openings in a pair of drawer fronts, such as those for the tool caddy. Clamp the two fronts together top edge to top edge, and mark the centerpoint for the openings. Then place the clamped assembly on top of a backer board on your drill-press table. Using the appropriate size Forstner bit, a hole saw, or a circle cutter for the desired opening radius, bore a hole through the fronts at the marked centerpoint, as shown at *right*.







Drill mounting holes through the bottom (J) and into the drawer frame (H/I) at the marked locations. Then drive the screws.

Slide into the drawers

1 From ½" plywood, cut the drawer sides (H) and drawer fronts and backs (I) to the sizes listed. From ¼" hardboard, cut the drawer bottoms/shelves (J) to size.

2 Cut ½" rabbets ⅜" deep along the ends of the fronts and backs (I), where shown on **Drawing 3**. Using a circle template or compass, mark a centered 1" radius on each of the two fronts, where dimensioned. Bandsaw and sand the openings to shape. Or see the **Shop Tip**, *opposite page*, for a time saving alternative.

3 Glue and clamp together the drawer sides, fronts, and backs, and check for square. After the glue dries, place the drawers on your workbench with the radiused openings facedown.

4 Mark the locations for mounting holes on the two drawer bottoms (J), where shown. (We marked the locations on white tape so we could easily see them.) Then position a bottom on each drawer, flush with the outside faces of the front and back and centered end-to-end with a 9/32" overhang on the sides, where shown. Clamp the bottom to the drawer. Now secure it in place, as shown in **Photo C**.

Top it off, and add the doors

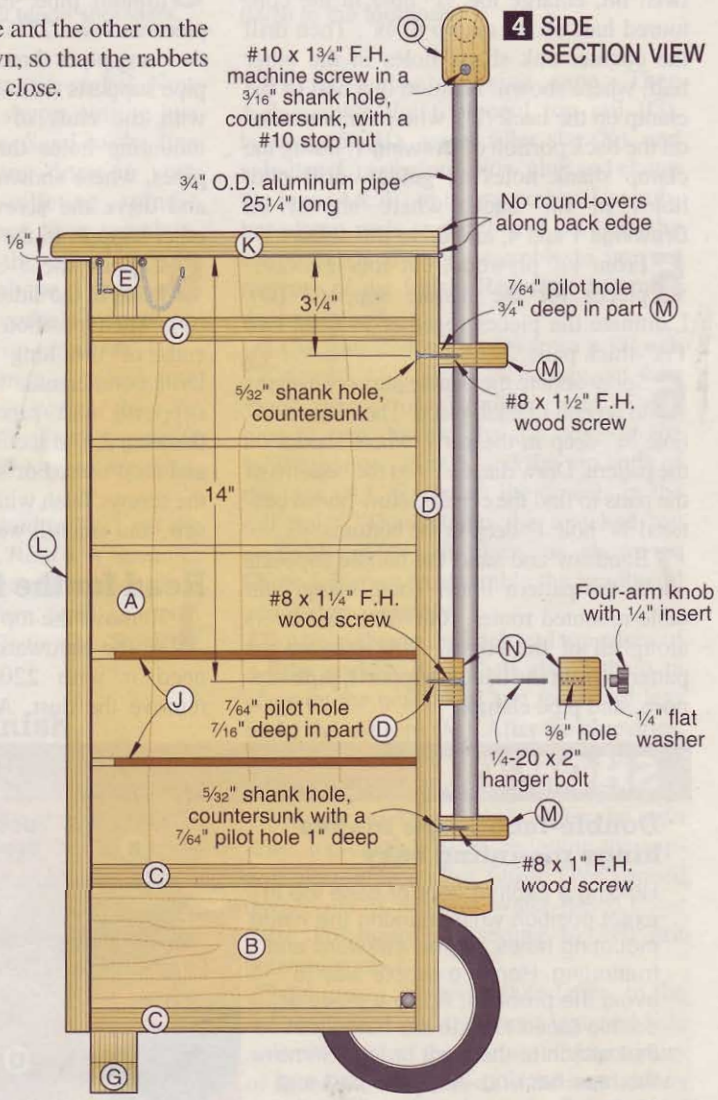
1 Cut the top (K) and doors (L) to size. Using your table-mounted router, rout a ⅛" round-over along the bottom front and side edges of the top, where shown on **Drawing 2a**. Switch to a ½" round-over bit, and rout the top edges. Now rout a ½" round-over along the long *outer* edge of each door on its *outside* face, where shown on **Drawing 2**.

2 Refit your router with a ⅜" rabbeting bit. Then rout a ⅜" rabbet ⅜" deep along the long *inner* edge of each door, cutting one door on the *outside* face and the other on the *inside* face, where shown, so that the rabbets overlap when the doors close.

Note: *We used #4×½" flathead wood screws to fasten the hinges to the Baltic birch plywood case. If you are using type AC or BC plywood, which may have voids between the plies, use 1"-long screws to help ensure an adequate grip in the plywood edges.*

3 Mount hinges on the front edge of the sides (A) and on the top edge of the back (D), where dimensioned. Align the hinges flush with the inside face of the sides and back.

4 Fasten the top (K) to the hinges with the top flush with the back of the case and centered side-to-side with a ½" overhang. Next attach the doors (L) to the hinges with the doors flush with the case sides and a ⅛" gap between the top edge of the doors and the top, where shown on **Drawing 4**. For an easy way to hold the parts in position while you mark the hinge mounting-hole locations, see the **Shop Tip** on the *next page*. Now mount draw catches on the doors, where dimensioned, using the screws supplied with the hardware.



Time for the handle

1 From ¾" plywood, cut four 2¼×9" pieces—two for the pipe supports (M) and two for the pipe clamp (N). Laminate the two pieces for the pipe clamp together to form a 1½"-thick workpiece.

2 Retrieve the pipe supports/pipe clamp patterns, and spray-adhere them to the three workpieces. Using a ¾" Forstner bit in your drill press, bore holes through the pieces, one piece at a time, where shown on the pattern and as shown in **Photo D**.

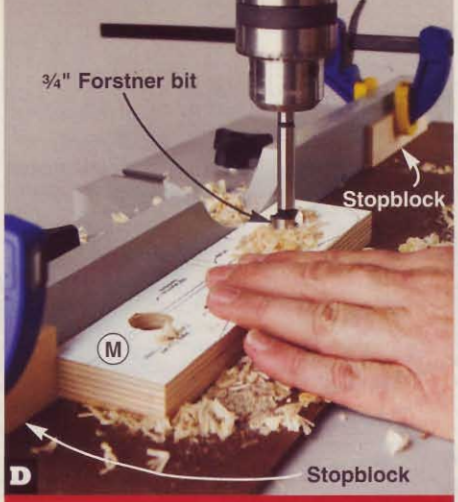
3 Bandsaw and sand the pipe supports and pipe clamp to the pattern line. Then rout ⅛" round-overs along the top and bottom edges, where shown. Now drill a centered ¼" hole only through the clamp.

4 Using your tablesaw, rip the pipe clamp (N) along the cutline, where shown. Next, using your drill press and a twist bit, enlarge the ¼" hole in the contoured half of the clamp to ⅜". Then drill the countersunk shank holes in the other half, where shown. Position this half of the clamp on the back (D), where dimensioned on the back portion of **Drawing 1**. Using the clamp shank holes as guides, drill pilot holes in the back, where shown on **Drawings 1** and **4**, and drive the screws.

5 From ¾" plywood, cut four 1½×2½" pieces for the handle supports (O). Laminate the pieces together to form two 1½"-thick pairs.

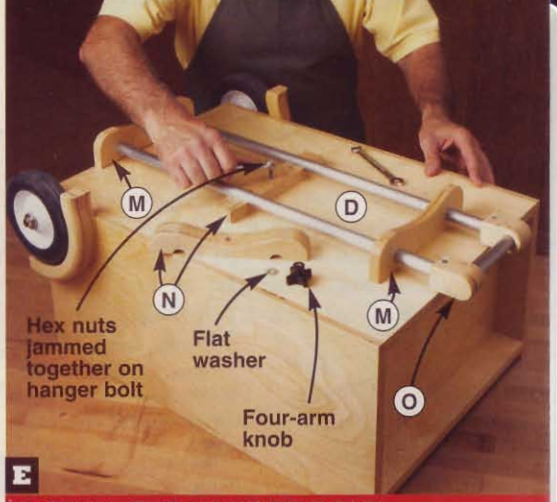
6 Spray-adhere the handle-support patterns to an end of each piece. Then bore a ¾" hole ¾" deep in the parts, where shown on the pattern. Draw diagonals on the bottoms of the parts to find the centers. Now bore a centered ¾" hole 1" deep in the bottoms.

7 Bandsaw and sand the handle supports to the pattern lines. Then, using your table-mounted router, rout ⅛" round-overs along all of the edges. Now remove the patterns from the handle supports, pipe supports, and pipe clamp.



BORE THE ¾" PIPE HOLES

Using stopblocks to precisely position the pipe supports (M) and pipe clamp (N), bore ¾" holes through each part at the marked centerpoints on the pattern.



INSTALL THE HANGER BOLT

Jam together two ¼-20 hex nuts on the hanger bolt. Drive it into the pipe clamp (N) by turning the nuts with a 7/16" wrench. Then remove the nuts.

8 From a 60"-long piece of ¾" O.D. aluminum pipe, hacksaw one 5½"-long piece and two 25¼"-long pieces. Slide the two long pipes through the holes in the two pipe supports (M). Align one support flush with the ends of the pipes. Then drill mounting holes through the support and pipes, where shown on **Drawings 2** and **4**, and drive the screws. Do not fasten the other support to the pipes.

9 Capture the 5½"-long pipe in the ¾" holes in the sides of the handle supports (O). Then position this assembly on the ends of the long pipes, where shown. Drill countersunk 3/16" holes through the supports and pipes, where shown on **Drawing 2**, and secure with machine screws and stop nuts. For safety, trim the ends of the screws flush with the nuts using a hacksaw, and smooth with a file.

Head for the finish

1 Remove the top (K), doors (L), and all of the hardware. Sand any areas that need it with 220-grit sandpaper, and remove the dust. Apply a clear finish, if you wish. (We applied three coats of Aquazar Water-Based Clear Satin Polyurethane to the caddy and aluminum pipes, sanding to 320 grit between coats.) If you plan to paint the caddy, first fill any voids with a paintable wood putty, and sand it smooth after it dries. Then prime and paint the unit.

2 From a ½" steel rod 36" long, hacksaw a 22"-long piece for the wheel axle. Insert the rod through the holes in the case sides (A), where shown on **Drawing 2**. Then install the flat washers, wheels, and push nuts on the axle. (We used a 6"-diameter lawnmower-type wheel with a steel hub.) Use a hammer to drive the push nuts.

3 To attach the handle assembly, drill two 5/32" shank holes through the back (D), where dimensioned on **Drawing 1**, for mounting the upper pipe support (M). Then countersink the holes on the *inside* face of the back. Next, with the tool caddy facedown on your workbench, install a ¼-20×2" hanger bolt in the center ¼" hole in the case-mounted part of the pipe clamp (N), as shown in **Photo E**. Now position the handle assembly on the unit, as shown, and install the contoured half of the pipe clamp, a flat washer, and a four-arm knob on the bolt.

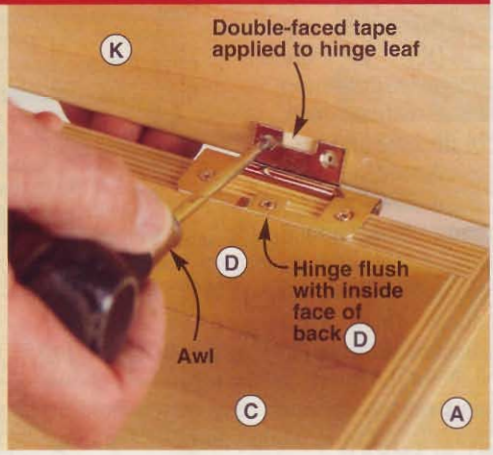
4 To secure the upper pipe support (M) to the back (D), position the handle to center the support over the shank holes in the back, and tighten the four-arm knob. Then, from inside the case and using the shank holes as guides, drill pilot holes through the support and pipes, where shown on **Drawing 4**. Now drive the screws.

5 Remount the top (K) and doors (L). To install a chain for holding the top open, drill pilot holes for 1" screw eyes in the left side (A) and top, where dimensioned on **Drawing 2**. Install the eyes. Then, using needle nose pliers, open the eyes, slip the ends of a 15" length of twisted-link chain

SHOP TIP

Double-faced tape makes hinge mounting easy

Holding a cabinet door or case top in exact position while marking the hinge mounting holes can be awkward and frustrating. Here's a simple way to avoid the problem. Apply a piece of double-faced tape to the hinge leaves that attach to the door or top. Remove the tape backing. Align the part and press it firmly in place to adhere it to the tape. Open the door or top and mark the mounting holes with an awl, as shown at *right*. Remove the tape, and drill the holes.



Quick and easy ideas for mounting your tools and accessories

The tool caddy doors provide a convenient place to keep frequently used tools accessible and organized. To hang your tools and keep them secure when moving the caddy, you don't need to spend a lot of money on fancy holders. Using small pieces of scrapwood, dowels, and aluminum bar, you can make attractive holders in minutes that custom-fit your tools, such as the ones shown in the photos *below*.

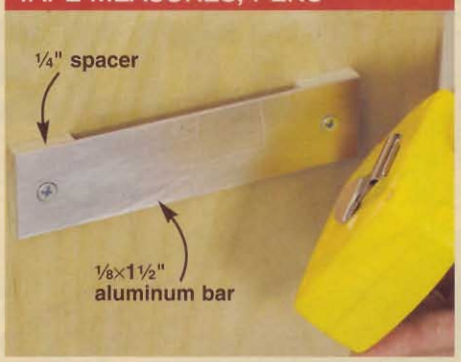
Start by removing the doors, placing them on your workbench, and laying out your tools on them. Make sure you leave enough clearance around the items for easy handling. Also, keep in mind that because the fixed shelves (C) extend to the front of the case, you need to keep the tools at least 2⅝" below the top of the doors and 5½" from the bottom. Ensure your tools and holders extend no more than 1½" from the doors so they'll clear the drawers and shelves when you close the doors.

To allow for easy rearrangement of your tools later, omit glue and simply screw the holders in place. If some of your tools have their own holders, you can mount them to the door too.

DRILL BITS

To make a holder for tools that fit in round holes, glue two pieces of ¾" scrap together. Drill stopped holes slightly larger than the bit-shank or tool diameters.

TAPE MEASURES, PENS



A piece of ⅛×1½" aluminum bar (available at hardware stores) and two ¼×1½×1½" wood spacers make a handy holder for items that have a spring clip.

SQUARES

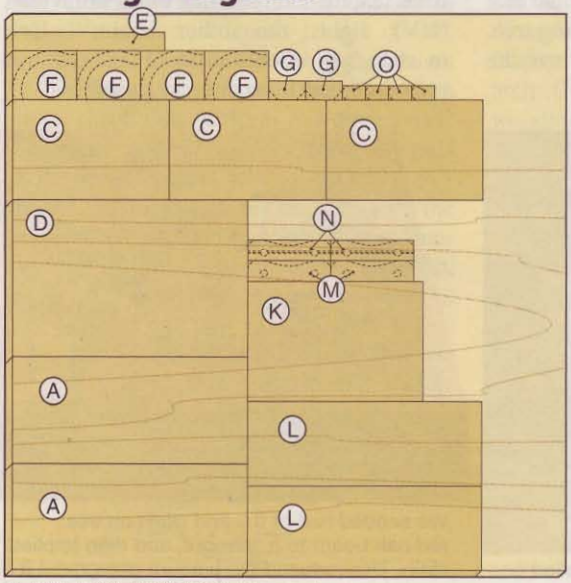
To create narrow slots, glue ⅛" spacers between strips of ¼" stock. A notched T-shaped holder made from ¼" stock keeps a sliding bevel securely in place.

onto them, and close the eyes. To secure the top when it is down, drill holes in the top divider (E) and the top, and install a 1" hook and screw eye, where shown.

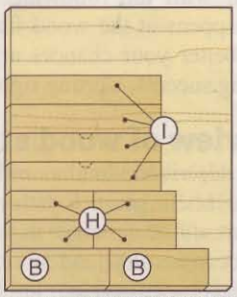
6 Slide the drawers and shelves (J) in place. Load the caddy with tools, hardware, and supplies and you're ready to roll to your work site. For ways to hang tools on the inside of the doors, see the sidebar "Quick and easy ideas for mounting your tools and accessories," *above*.

See more
shop project plans at
woodmagazine.com/shoptools

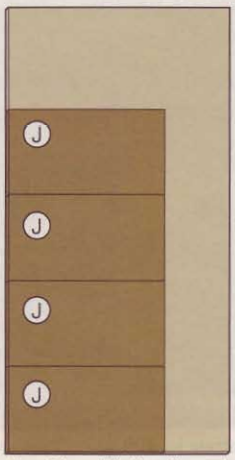
Cutting Diagram



¾ x 60 x 60" Baltic birch plywood



½ x 24 x 30" Baltic birch plywood



¼ x 24 x 48" Hardboard

Materials List

Part	FINISHED SIZE T	W	L	Matl.	Qty.
A sides	¾"	11½"	25½"	BB	2
B axle supports	½"	4"	10¾"	BB	2
C fixed shelves	¾"	10¾"	17"	BB	3
D back	¾"	17"	25½"	BB	1
E top divider	¾"	2"	16½"	BB	1
F fenders	1½"	5¼"	7"	LBB	2
G brace	1½"	2"	4"	LBB	1
H drawer sides	½"	3⅛"	9"	BB	4
I drawer fronts and backs	½"	3⅛"	16⅜"	BB	4
J drawer bottoms/ shelves	¼"	9¼"	16 15/16"	H	4
K top	¾"	12 3/16"	19"	BB	1
L doors	¾"	9⅛"	25⅜"	BB	2
M pipe supports	¾"	2¼"	9"	BB	2
N pipe clamp	1½"	2¼"	9"	LBB	1
O handle supports	1½"	1½"	2½"	LBB	2

Materials key: BB–Baltic birch plywood, LBB–laminated Baltic birch plywood, H-hardboard.

Supplies: Spray-adhesive, 2½" no-mortise hinges (6), #4×½" flathead wood screws (30), #8×1" flathead wood screws (30), #8×1¼" flathead wood screws (2), #8×1½" flathead wood screws (2), #10×1¾" flathead machine screws (2), #10 stop nuts (2), draw catches (2), ¾" O.D. aluminum pipe 60" long, paintable wood putty, double-faced tape, ½" steel rod 36" long, 6"-diameter wheels with a ½"-diameter hub (2), ½" flat washers (2), ½" steel push nuts (2), ¼-20×2" hanger bolt, ¼-20 hex nuts (2), ¼" flat washer, four-arm knob with ¼" insert, 1" screw eyes (2), twisted-link chain 15" long, 1" hook and screw eye.

Blades and bits: Dado-blade set, ⅛" and ½" round-over and ⅜" rabbeting router bits, ¾" and 2" Forstner bits.

Written by **Owen Duvall** with **Chuck Hedlund**
Project design: **Kevin Hall**, Tremonton, Utah, with **Kevin Boyle**
Illustrations: **Roxanne LeMoine**

Part IV: success with staining and finishing

Face grain
End grain
Wood fibers magnified to show structure
Pigment particles lodge in pores and surface irregularities.

Finish quality can make or break a project. Just as people desire to touch an immaculate finish, they also can immediately detect one that's flawed. Whether the color is not right or the surface is rough, a bad finish can spoil your efforts at fine craftsmanship.

For this reason, many of us find staining and finishing downright intimidating. And too often we don't understand how wood will react to the coatings we apply. So arm yourself with the following insights into what happens at the wood fiber level, and you'll better your chances at staining and finishing success, starting right now.

A review of wood structure

We've described wood as millions of tiny, tubelike fibers glued together, *above*, that transport and store water in the living tree. They become dry and shrink when the wood gets processed into lumber.

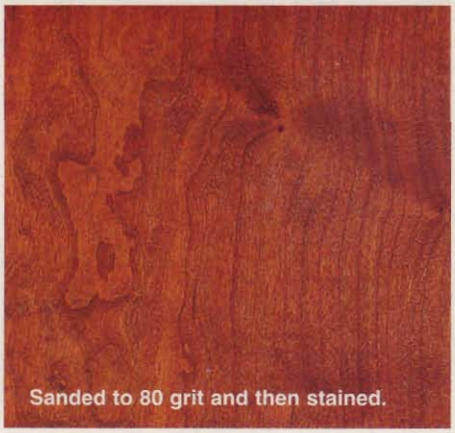
Because the majority of these fibers run lengthwise in a board, the face or edge surfaces reveal the sides of the fibers. The end of a board shows the fiber's open ends, often called pores.

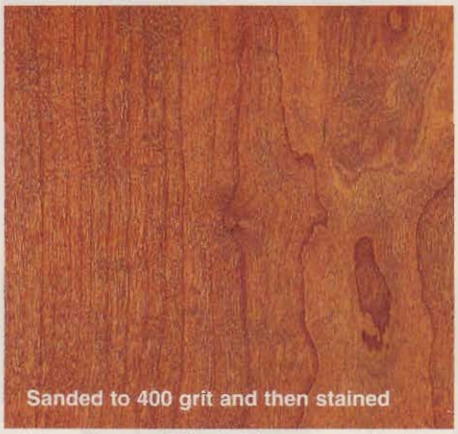
A few fibers, mainly rays, run across the board. And lengthwise fibers get twisted around branches. This means you'll likely encounter open pores on all board surfaces.

Why wood needs a finish

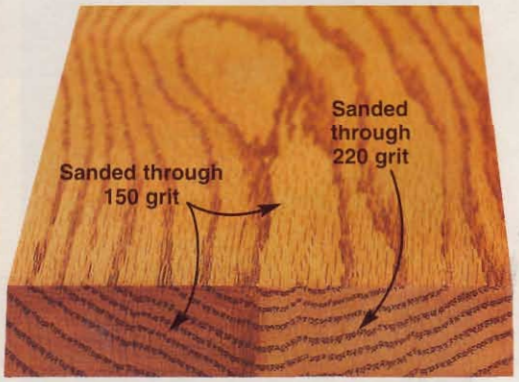
Wood, even when dried into lumber, can shed and absorb moisture. So we need to seal it with a finish. Doing this slows, but doesn't stop, the transfer of moisture into and out of wood fiber walls. This, in turn, minimizes seasonal expansion and contraction caused by changing humidity.

Finish also helps preserve wood color by slowing the process of oxidation, which can darken woods such as cherry, and lighten others such as walnut. Some types of finishes feature additives that block ultraviolet (UV) light, the other main culprit in changing wood's color. Finally, finish protects wood from dirt and scratches.





We sanded the cherry sample at left to 80 grit, and the other to 400 grit. Then we applied one coat of the same cherry stain to both boards, producing very different tones.



We sanded half of the end grain on this red oak board to a finer grit, and then applied stain. This reduced the amount of pigment it could hold. The result: consistent color.

Two ways to color wood

In some cases, we want to change the color of wood to create a certain look, to even out inconsistent wood tones, or to hide sapwood. This also can give fresh wood an aged look, or make one wood imitate another.

To do this, coat the wood with either pigmented stains or dyes. While these two substances accomplish the same goal, wood accepts them differently.

Stain. Pigmented stains (usually called just "stain") consist of tiny pigment particles and binder suspended in a solvent. Stains build up on the wood surface, as shown *below*.

This means that the smoother the wood surface, the less stain it accepts, as fine sanding removes scratches where the pigment can take hold. See the difference, *previous page, bottom left*.

Sanding doesn't close pores, though, so pigment still accumulates in them. This highlights contrasts in grain figure, especially in open-pored woods and in species that have widely varying pore sizes, such as red oak and pine. You can see this in the photo, *top right*.

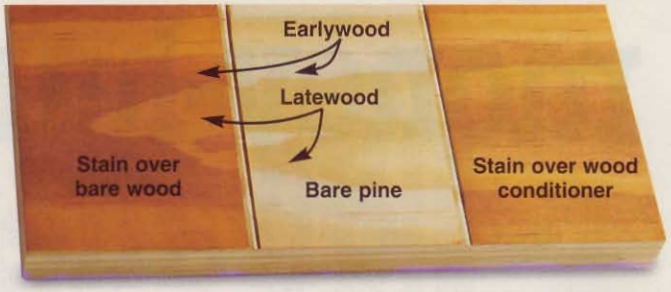
The ends of a board, too, are naturally porous. They stain darker than the face of a board, as seen, *previous page bottom right*.

You can minimize color inconsistencies by first coating the wood with a stain conditioner to partially seal the pores. Or choose a gel stain—wood pores can't accept as much of the thickened solvent in these stains, yielding a more-even color.

Dye. In contrast to stains, dyes—typically aniline—contain pigments that are soluble (dissolving). Dyes are usually sold as a powder that dissolves in either water or alcohol.

Rather than remain on the wood surface, dyes soak in. This lets the figure show through because dyes actually change the color of the wood fibers, rather than cover up the fibers with pigment particles, as stain would. Plus, dyes produce a more-even tone than do stains. For these reasons, dyes generally perform better on figured stock because they don't obscure the grain. Dyes also excel for coloring dense woods, such as maple, that don't offer many places for stain pigments to lodge, as seen in the photo, *above*.

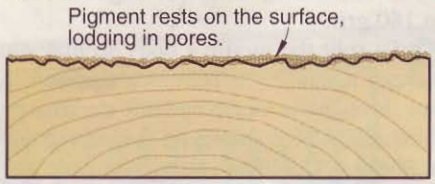
Dyes do tend to fade more than pigmented stains, though water-soluble versions resist fading better than alcohol-soluble dyes. The latter also can be trickier to apply. Learn about using dye in issue 157, page 42.



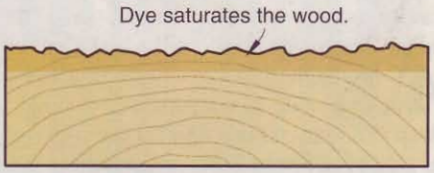
The center of this pine board shows the light-colored earlywood and dark latewood. The colors "reverse out" when stained because more pigment lodges in the porous earlywood (left). Stain conditioner (right), reduces this effect by partially sealing the pores.

Maple has small, dense pores, so it doesn't provide many places for stain pigment particles to lodge, as shown (left). A dye (right), colors the wood evenly, regardless of pore size.

HOW WOOD ACCEPTS STAIN AND DYE



Pigment particles lodge in open pores, sanding scratches, and nooks and crannies on the wood surface without soaking in.



When applied to the wood, dyes soak into the walls of the wood fibers, actually changing their color.

SHOP TIP

How much sanding is enough?

In the *WOOD*® magazine shop, we generally sand through 180 grit when applying a film-forming finish. We sand through 220 to give a smoother feel to woods that will get penetrating oil finish.

On projects that will be stained, we sand through at least 180 grit using a random-orbit sander, and then proceed through 220 or 320 grit on end grain and areas that require hand-sanding.

Clear choices in topcoats

If you don't want to color the wood, you can skip straight to the topcoat. Though many types of clear topcoats exist, they fall into two broad groups based on how the wood accepts them.

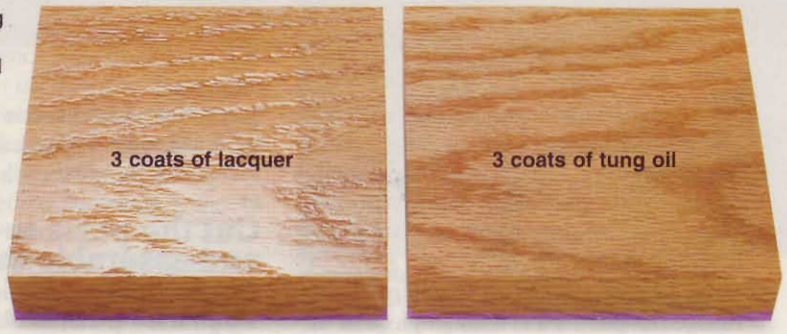
Some topcoats, such as lacquer and polyurethane, remain on the wood surface rather than soak in. These film-forming finishes seal the wood and create a shell that thickens and develops a glossy sheen as you apply more coats, as seen on the left-hand sample, *below*. Film-forming finishes offer protection from abrasion and liquids.

Wood soaks up some topcoats, such as oils. These penetrating finishes reduce moisture exchange and beautify wood, yet protect the wood surface little. You can see an oil finish on the right-hand board, below.

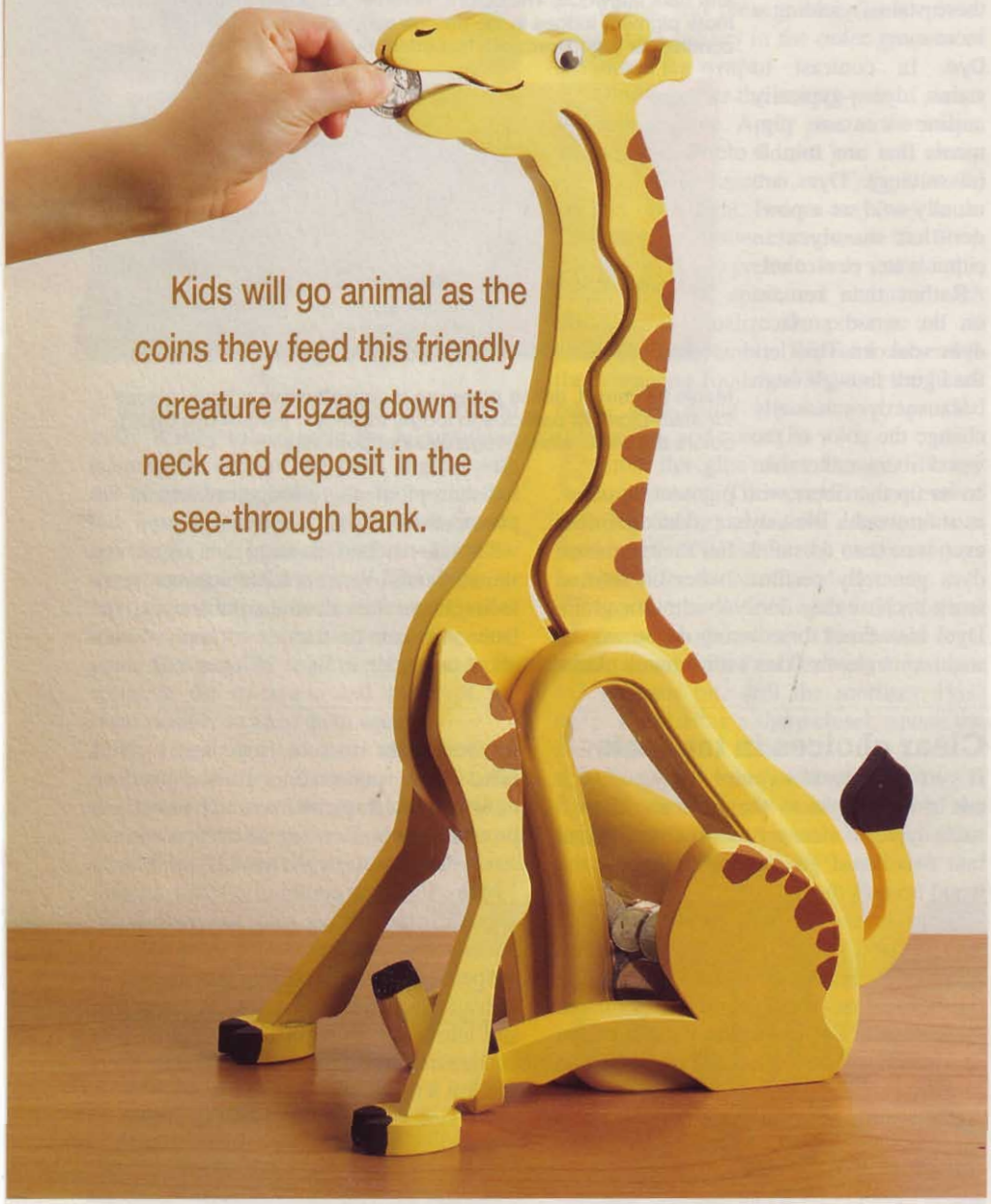
Many topcoats combine oil and another substance, usually varnish, to create finish with both penetrating and film-building properties. Called wiping varnishes or oil/varnish blends, these are easy to apply, and allow you to regulate how much film you create. You'll have to apply many coats to form a thick, protective film.

Written by **David Stone** Illustration: **Eric Flynn**

The film-forming finish (lacquer) used on one red oak board enhances the differences in pore sizes. A Penetrating finish (tung oil) makes the differences in pore size less obvious.



money-hungry giraffe



Kids will go animal as the coins they feed this friendly creature zigzag down its neck and deposit in the see-through bank.

Looking for a project that uses few materials and tools and will give a child an early start on saving? You've come to the right place. With only a scrollsaw, router table, and stationary belt/disc sander for tools, and a 12×24" piece each of ½" and ¾" medium-density fiberboard (MDF) and a small piece of ⅛" acrylic for materials, you have what it takes to build this whimsical kids' bank. It accepts all coins except a half-dollar.

Cut the parts to shape, and assemble the body

1 Make four photocopies of the full-size giraffe patterns on the *WOOD Patterns*® insert. Spray-adhere the body pattern and two copies of the side pattern to ¾" MDF. Then adhere the tail pattern, two copies each of the front and rear leg patterns, and four copies of the hoof pattern to ½" MDF.

2 Using your scrollsaw with a no. 12 blade, cut the parts to shape, staying outside the mouth on the body. (You'll cut the mouth to shape after forming the coin slot.) Then drum-sand the edges smooth to 180 grit.

3 To split the giraffe's body so that you can machine the coin slot, first scrollsaw through the mouth and into the sinuous view slot, where shown on the pattern and in **Photo A**. Continue cutting along the pattern lines to form the view slot and bank cavity. Then cut along the centerline for the 1" hole at the bottom to separate the body. Drum-sand the view slot and bank cavity edges smooth. Do not sand the edges where you'll rejoin the body halves.

4 Using a three-wing ⅛" slotting cutter in your table-mounted router, cut a ½"-deep slot in each body half for the coin slot, as shown in **Photo B**. Keep the pattern side of each half faceup to ensure the slots align. Then, using five-minute epoxy (see the **Shop Tip**, *opposite page, far right*), join the body halves together, being careful to remove any squeeze-out from the coin slot.

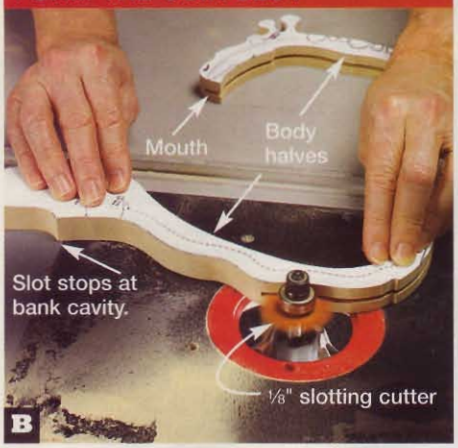
5 After the epoxy cures, scrollsaw the mouth to shape. Then drill a 3/32" blade start hole, where shown on the pattern, and scrollsaw out the nostril.

6 Drill a 3/32" blade start hole through the two side pieces, where shown on the pattern. Then cut the inside of the pieces to shape, staying approximately ⅛" inside the pattern line. (You'll flush-trim each side opening to match the body bank cavity contour after epoxying the pieces to the body.) Refit your table-mounted router with a ⅜"

SEPARATE THE BODY

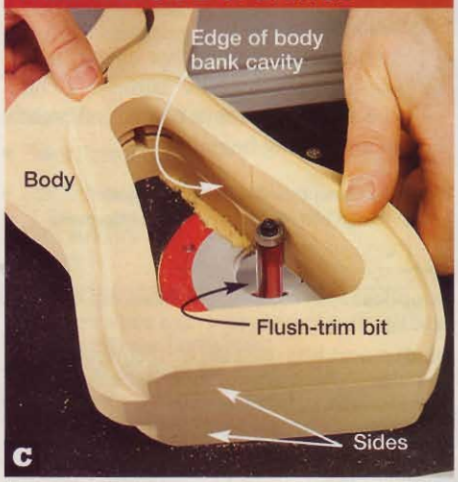
Begin scrollsawing through the giraffe's body by cutting through the center of its mouth and then into the view-slot area.

FORM THE COIN SLOT



Using a slotting cutter, cut a centered ⅛" slot ½" deep from the mouth to the bank cavity opening in each body half.

TRIM THE SIDE OPENINGS



Center a flush-trim bit bearing on the edge of the body bank cavity. Trim one side, and then turn the assembly over and repeat.

round-over bit. Now round over one edge of each piece, where shown on **Drawing 1**, making sure they are mirror-image parts.

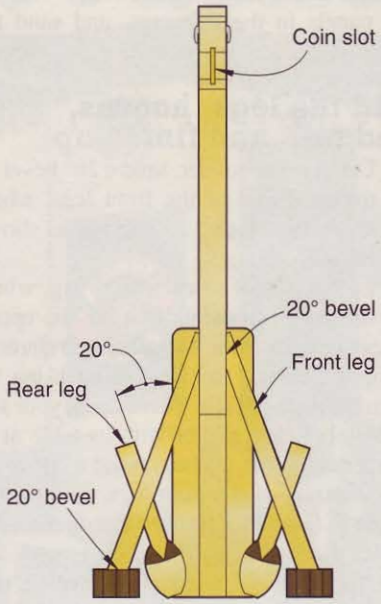
7 Remove the patterns from all of the parts using a solvent, such as lacquer or paint thinner.

8 Epoxy and clamp the sides to the body, positioning them flush with the body bottom and centering their undersize openings over the body bank cavity. When the epoxy cures, trim the side openings flush with the cavity using a bearing-guided flush-trim bit, as shown in **Photo C**.

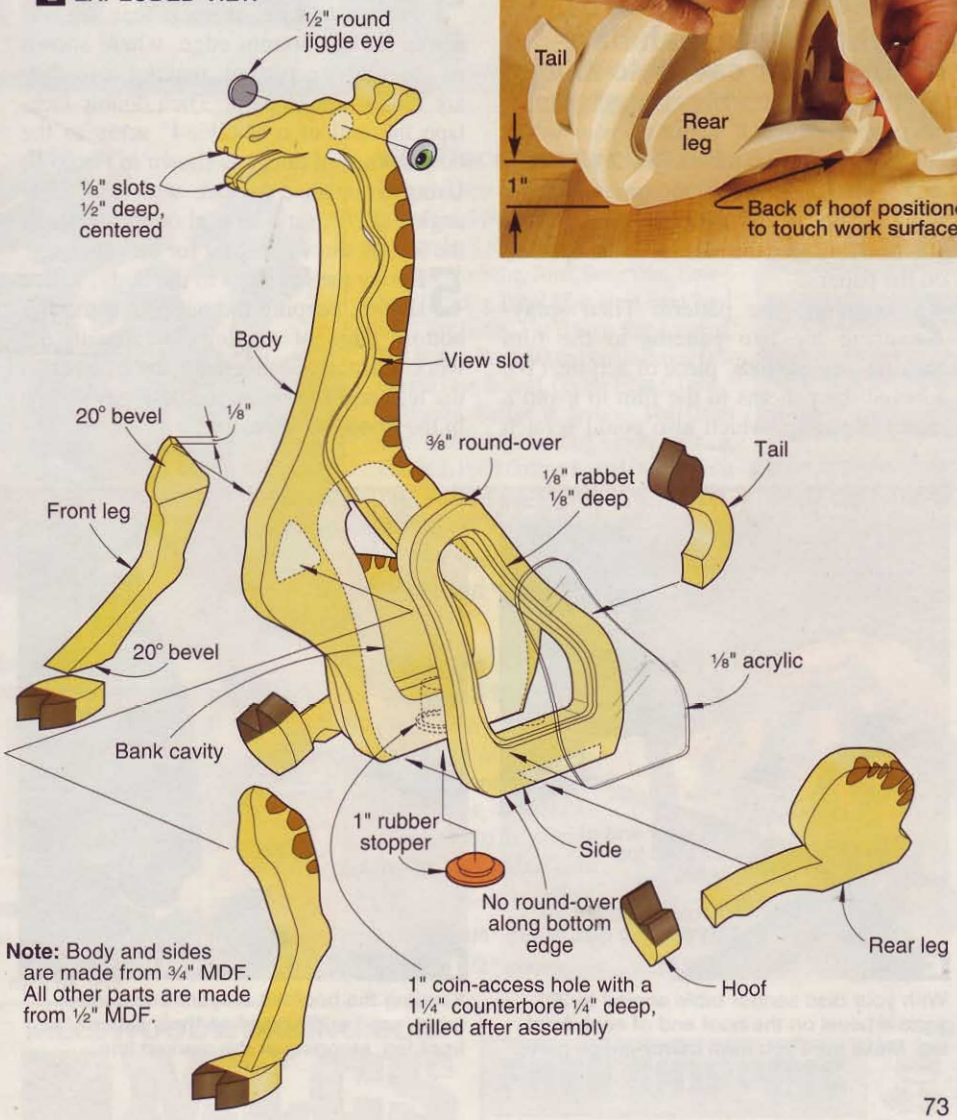
9 Refit your table-mounted router with a rabbeting bit. Then rout a ⅛" rabbet ⅛" deep along the inside edge of each side piece, where shown, to receive the acrylic panels.

10 To form a 1" coin-access hole in the bottom of the body/sides, first drill a ¼"-deep counterbore centered side-to-side, where dimensioned on the body pattern, using a 1¼" Forstner bit. Then switch to a

1a FRONT VIEW



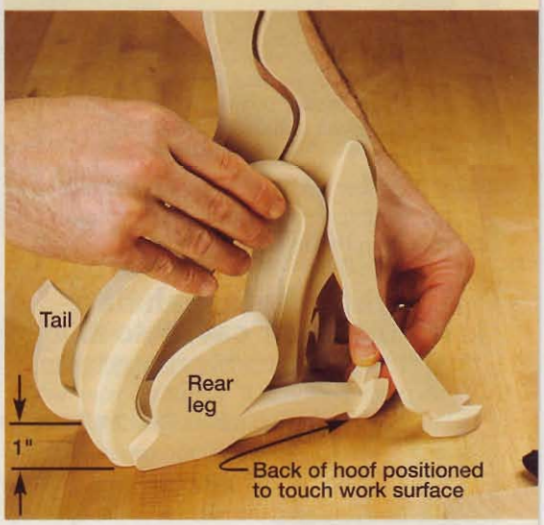
1 EXPLODED VIEW



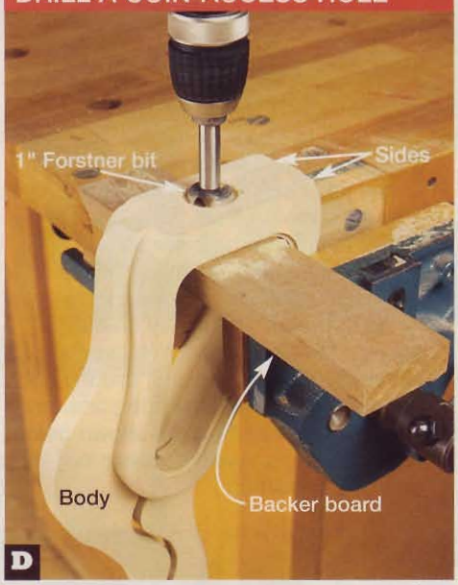
SHOP TIP

Epoxy: A quick and handy way to join parts without clamps

Ever tried to glue together small, odd-shape parts and struggled with how to clamp them securely? Here's a simple way to fix the problem. Use five-minute epoxy to adhere the parts and hold them together with your hands until the epoxy sets (the parts stay in position when you let go of them). The epoxy creates a strong, gap-filling bond. We used epoxy to assemble the giraffe bank, making it easy to adhere its irregular-shape parts, such as the hooves and tail, as shown *below*, without clamps. Avoid squeeze-out—it's difficult to clean up.



DRILL A COIN-ACCESS HOLE



Clamp the body/sides in a vise supported on a 2"-wide backer board. Drill a 1" through-hole centered in the 1¼" counterbore.

1" Forstner bit, and drill a hole centered in the counterbore through the bottom, as shown in **Photo D**.

Cut the acrylic panels for the bank cavity to shape

1 To make a pattern for the acrylic panels, place an 8½×11" paper on your workbench, and position the body/side assembly with a side facedown on the paper. Using a short, sharp pencil inserted through the bank cavity, trace the side rabbeted opening on the paper.

2 Photocopy the pattern. Then spray-adhere the two patterns to the film backing on a ⅛×6×8" piece of acrylic. (We adhered the patterns to the film to avoid a messy clean-up, which also could scratch the acrylic.) Using a no. 2 blade in your scrollsaw, cut the panels to shape. Test-fit the panels in the openings, and sand the edges, if needed, to fine-tune their shape.

Add the legs, hooves, and tail, and finish up

1 Using a disc sander, sand a 20° bevel on the hoof end of the front legs, where shown on **Drawings 1** and **1a** and as shown in **Photo E**.

2 Epoxy a hoof to each front leg, where shown on **Drawing 1**. After the epoxy cures, draw a line for sanding reference along the curved top edge of each leg ⅛" from the *outside* face. Then, using your stationary belt/disc sander with its table at 0° (perpendicular to the belt), sand a 20° bevel on the *inside* of the front legs, as shown in **Photo F**. (Holding the hoof flat on the table angles the leg at 20° to the belt.)

3 Apply epoxy to the leg beveled surfaces. Then, with the body/side assembly upright on your workbench, adhere the legs to the body, where shown, keeping the hooves flat on the work surface.

4 Draw a sanding reference line along the *inside* face of each rear leg ⅜" above its flat bottom edge, where shown on the rear-leg pattern, making sure they are mirror-image parts. Then double-face-tape the end of a ¾×2½×4" scrap to the outside face of a leg, as shown in **Photo G**. Using your disc sander with the table angled at 20°, sand a bevel on the *inside* of the leg, as shown. Repeat for the other leg.

5 Epoxy the rear legs to the body, where shown, keeping the outside of the flat bottom edge of the legs flush with the work surface. Then epoxy the hooves to the legs and the tail to the body, as shown in the **Shop Tip** photo.

6 Sand any areas that need it to 180 grit. Prime and paint the giraffe. (We applied three coats of Rust-Oleum grey primer, sanding to 320 grit between coats. Then we sprayed three coats of Rust-Oleum American Accents no. 7962 Buttercup Satin, sanding between coats as needed. We found these items at a home center.)

7 Epoxy ½" round jiggle eyes to the body where shown. Then apply a few dabs of epoxy around the rabbets in the sides and press the acrylic panels in place.

8 Using a no. 4 round artist's brush suitable for acrylic paint and contrasting paint colors of your choice, paint spots on the giraffe body, legs, tail, and hooves, where shown on **Drawing 1** and the patterns. (We used Delta Ceramcoat acrylic paints, Raw Sienna for the body and legs and Burnt Umber for the hooves and tail. See **Sources**. Find the brush at art and crafts supply stores.)

9 Finally, install a 1" rubber stopper in the coin-access hole. Now surprise a child with the bank and some coins, and watch the fun and saving begin!

Written by **Owen Duvall** with **Kevin Boyle**
Project design and illustrations: **Mike Mittermeier**

Supplies: Spray adhesive, five-minute epoxy, double-faced tape, ⅛×6×8" acrylic, no. 4 round artist's brush.

Blades and bits: No. 2 and no. 12 scrollsaw blades; three-wing ⅛" slotting cutter, ⅜" round-over, bearing-guided flush trim, and rabbeting router bits; 1" and 1¼" Forstner bits.

Sources

Hardware and acrylic paints. ½" round jiggle eyes no. 5608, $.59 package of 10; 1" rubber stopper no. 7830, $2.99 package of 10; Delta Ceramcoat Acrylic Paints no. 02025 Burnt Umber and no. 02411 Raw Sienna, $1.99 each. Call Meisel Hardware Specialties, 800/441-9870; meiselwoodhobby.com.

FORM BEVELS ON THE GIRAFFE LEGS USING THESE THREE SIMPLE SANDING SETUPS

With your disc sander table angled to 20°, sand a bevel on the hoof end of each front leg. Make sure you form mirror-image parts.

Sanding reference line marked on top edge
Right front leg (inside face)
Sanding belt
Hoof flat on table
Table at 0° to sanding belt
F

Keeping the hoof flat on your belt sander table, sand a 20° bevel on the inside of the front leg, stopping at the marked line.

Holding the scrap with attached rear leg flat on your disc sander table, sand a 20° bevel on the leg inside face to the marked line.

WORKSHOP WORKOVER

In two days we cured a reader's shop of its clutter and transformed it into a fully functioning workplace bursting with simple, adaptable ideas. Take what you need to give your shop a boost.

The news is shocking but true: Our shops are in clutter crisis. Most are so stuffed with tools and supplies that little space remains for projects.

So we've been hard at work on cures. To prove they work, we asked you to submit your shops for a field trial. From hundreds of replies, we selected Jerry Mertens' shop in Forsyth, Missouri.

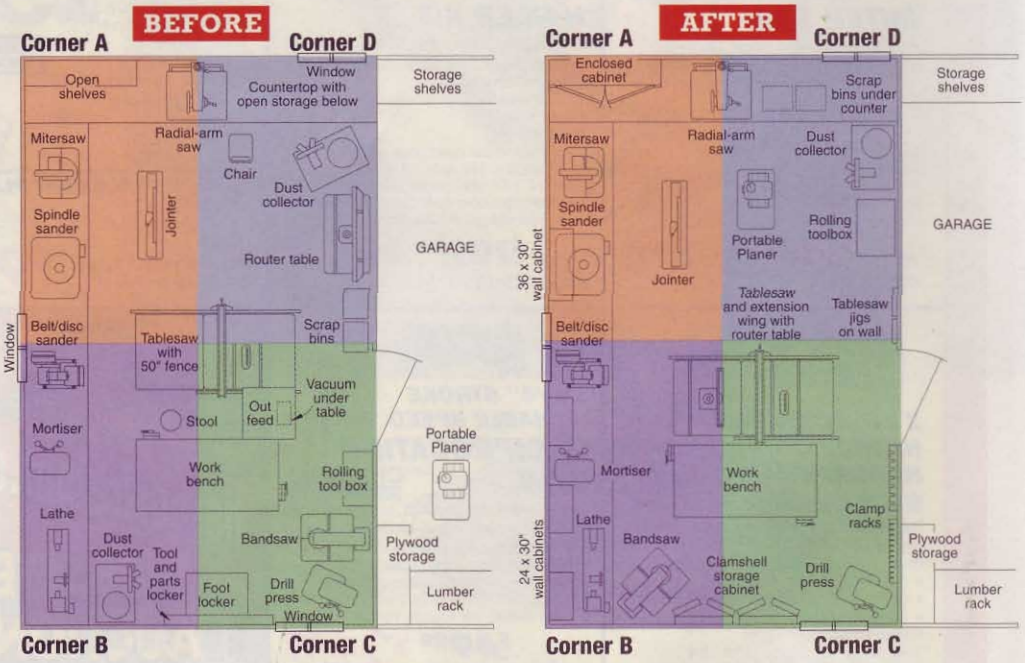
His place showed all the symptoms of a sick shop, visible in the "before" photos and floor plan. During our visit, we cured his shop with simple solutions that you can use to work over your work space.

THE SICKNESS: Shop layout hinders workflow

Like most shops, Jerry's evolved over time. As new tools and jigs entered, they were positioned wherever they'd fit.

THE CURE: Rearranging does the trick

We relocated Jerry's tools and supplies where they belong, instead of wherever space allowed. The "after" floor plan, *right*, shows that tools for breaking down boards—radial-arm saw, jointer, and planer—reside on one end of the shop. Tools for machining parts, handwork, and assembly live on the other end. Jerry now has easy access to everything.

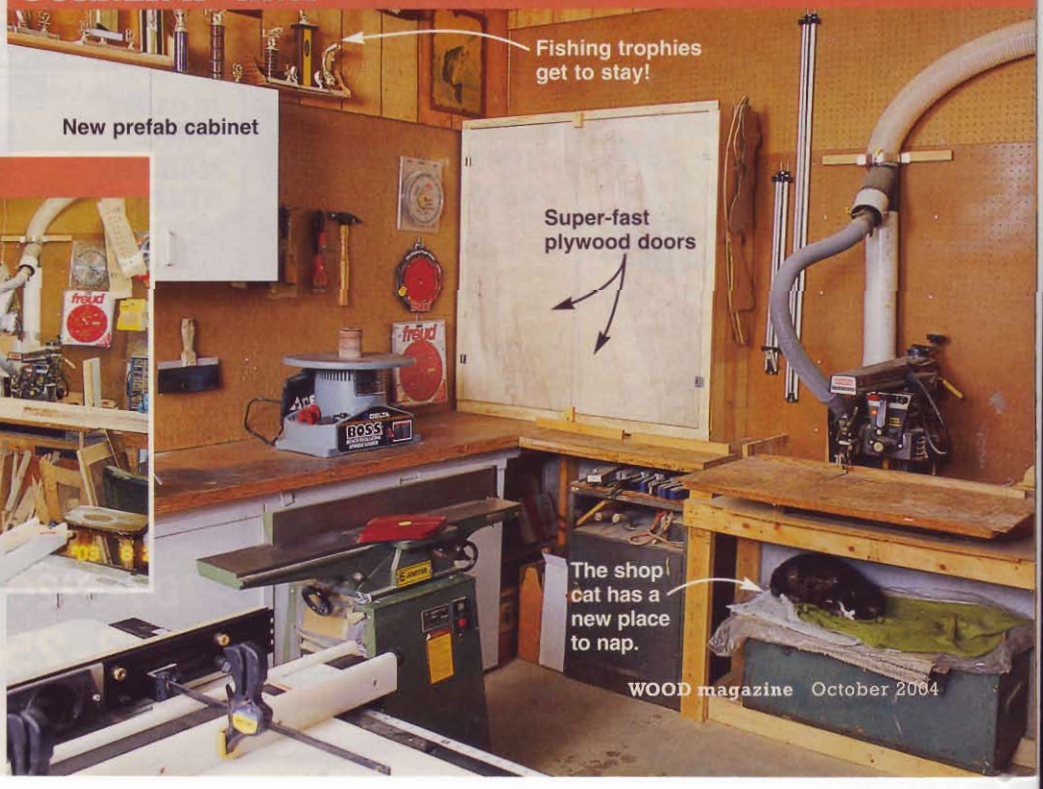


Before the workover began, Jerry's shop was crowded and inefficient. Afterward, the shop is effectively arranged and the walls hold cabinets instead of dust-covered packages and tools.

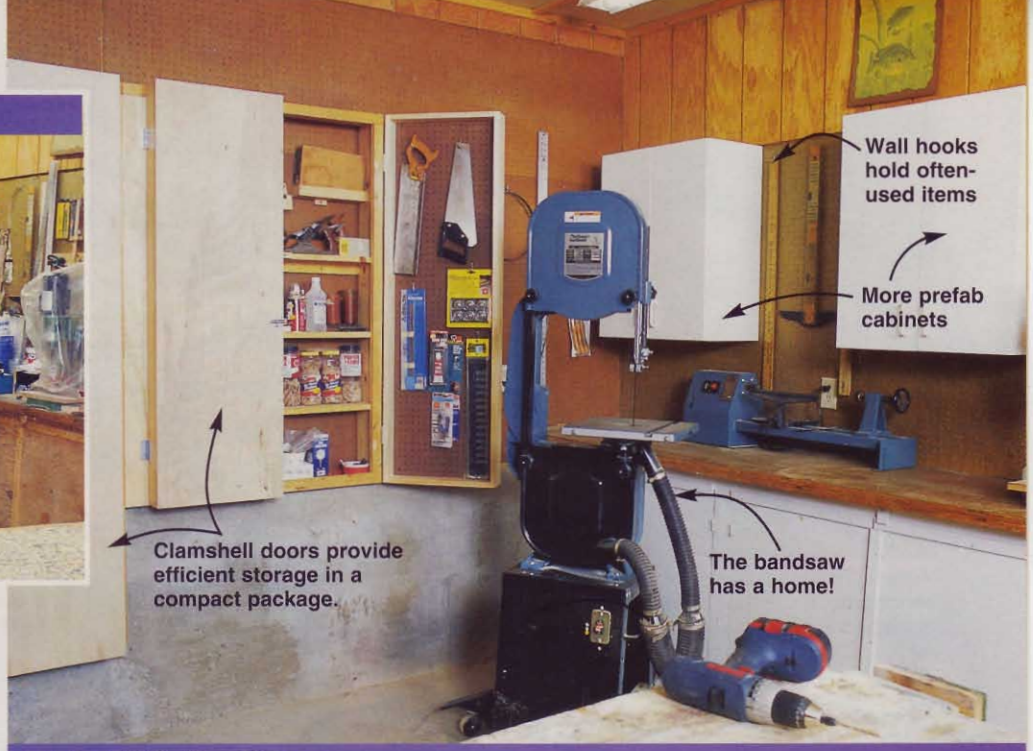
CORNER A—Before

Every shop wall was filled with an overload of disorganized hooks and hanging items.

CORNER A—After



CORNER B—Before


Wall hooks hold often-used items
More prefab cabinets
Clamshell doors provide efficient storage in a compact package.
The bandsaw has a home!

CORNER B—After

Jerry's shop now sports a clean countertop and loads of enclosed cabinet space. Using a combination of shop-built and store-bought units allows easy customization.

THE SICKNESS: Faltering finish storage.

Jerry's storage for finishing supplies consisted of a set of simple shelves (see *Corner A—Before* photo). They swallowed stain and finish cans, and gobbled up loads of dust and clutter.

THE CURE: A fast facade creates a cabinet

Two ½"-plywood doors hinged to a face frame made of scrap stock put this problem under wraps. Secured by wood turn buttons, the doors keep dust out, and cans in (see *Corner A—After* photo).

THE SICKNESS: Lack of enclosed storage

Perforated hardboard offers versatile storage; but in Jerry's shop, this storage system was hooked on clutter. One wall was packed with hooks that held most anything you could think of, much in its original packaging (see *Corner A—Before* photo).

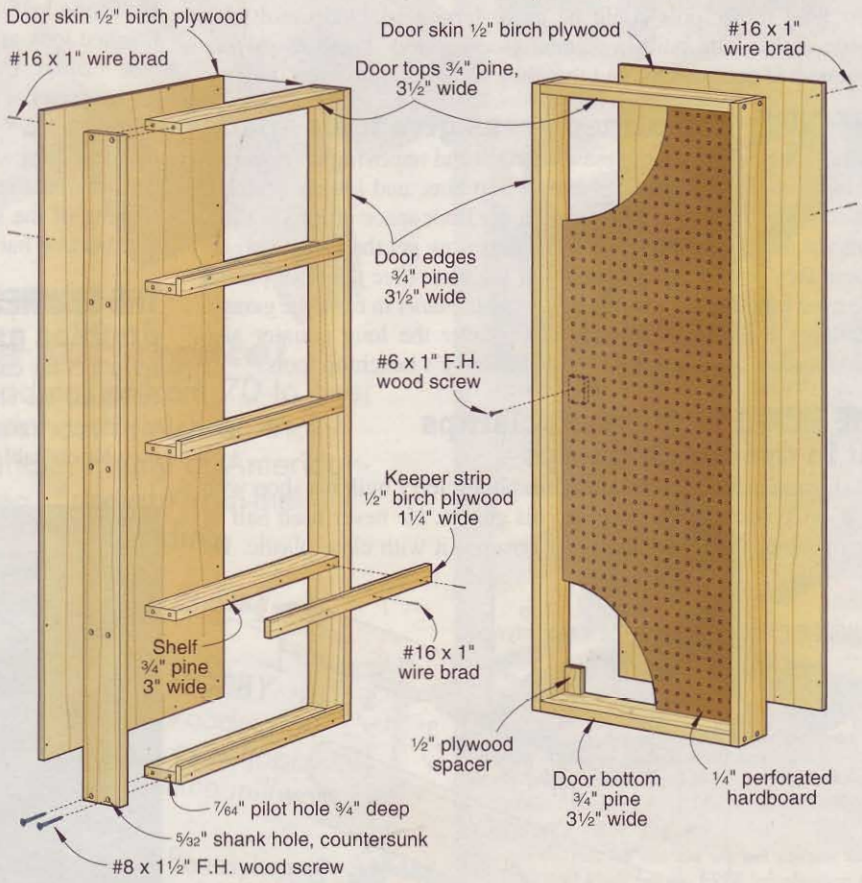
THE CURE: Prefab cabinets create a quick solution

To provide storage, we hung four ready-to-assemble prefab cabinets purchased at a home center (see *Corner B—After* photo). These units install quickly and—at $50 and $75 apiece depending on size—prove economical when compared to building your own cabinets .

THE SICKNESS: A single cabinet gets crammed-full

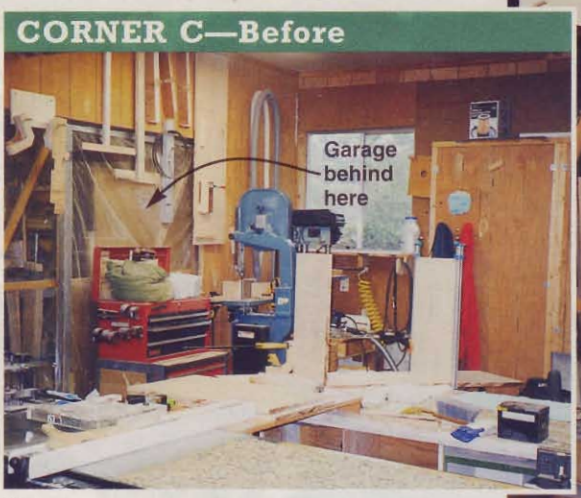
Jerry had built one four-door wall cabinet (see *Corner B—Before* photo). It proved suitable for holding jars of screws and a few supplies. But at only about 4" deep, it couldn't accept much else. This cabinet location near the bench proved ideal, though, for turning the cabinet into a home for hardware and hand tools.

CLAMSHELL CABINET DOORS (two options)

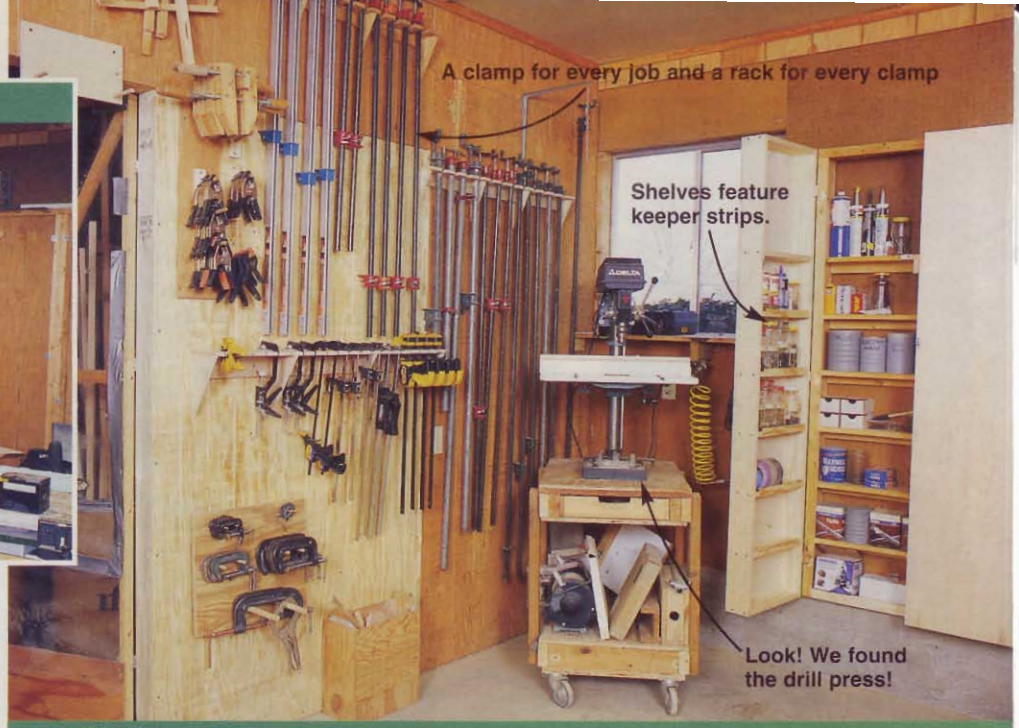

Door skin ½" birch plywood
#16 x 1" wire brad
Door skin ½" birch plywood
#16 x 1" wire brad
Door tops ¾" pine, 3½" wide
Door edges ¾" pine 3½" wide
#6 x 1" F.H. wood screw
Keeper strip ½" birch plywood 1¼" wide
Shelf ¾" pine 3" wide
#16 x 1" wire brad
½" plywood spacer
Door bottom ¾" pine 3½" wide
¼" perforated hardboard
7/64" pilot hole ¾" deep
5/32" shank hole, countersunk
#8 x 1½" F.H. wood screw

THE CURE: Deep shop-built doors hold more

We turned this space-impaired cabinet into a storage superstar by equipping it with clamshell doors. (See the drawing, *above* and *Corner B—After* photo). Inside one pair, perforated hardboard offers effective hanging storage. Another option: Add shelves inside the doors. Jerry plans to load this cabinet with more hardware and hand tools.



You can never have enough clamps, or rack space to hold them. The drill press, which was crammed into a corner, now can be used anytime and is surrounded by plenty of work space.


A clamp for every job and a rack for every clamp
Shelves feature keeper strips.
Look! We found the drill press!
CORNER C—After

THE SICKNESS: Tools have no place to call home

When we arrived in Jerry's shop, we found the bandsaw and drill press shoved into a corner due to lack of open floor space (see *Corner C—Before* photo). Both machines had to be pulled out into the room for use.

At least those tools could be used. Jerry's benchtop tools that reside on his long built-in counter (see *Corners A* and *B—Before* photos) had gotten so buried that they were tough to even find.

THE CURE: Reclaimed areas give tools space

Pushing the bench and tablesaw together and removing unnecessary items, such as a foot locker, extra scrap bins, and loads of lumber cut-offs, freed up about 20 percent more floor space in Jerry's shop. This means the bandsaw and drill press now get their own corners where they're easy to use but out of the way. (See the floor plans.) We even found space to bring the portable planer in from the garage.

Solving the on-wall storage issues over the long counter also made more usable space available for Jerry's benchtop tools.

THE SICKNESS: Jigs and clamps sit in the wrong camps

As shown in the *Corner C—Before* photo, Jerry built his shop with an 8'-wide doorway leading into his garage. He never used half of the opening, though, and simply covered it with clear plastic. He hung a few tablesaw jigs on the wall (in a location not handy to the saw) and parked a rolling toolbox in front of it.

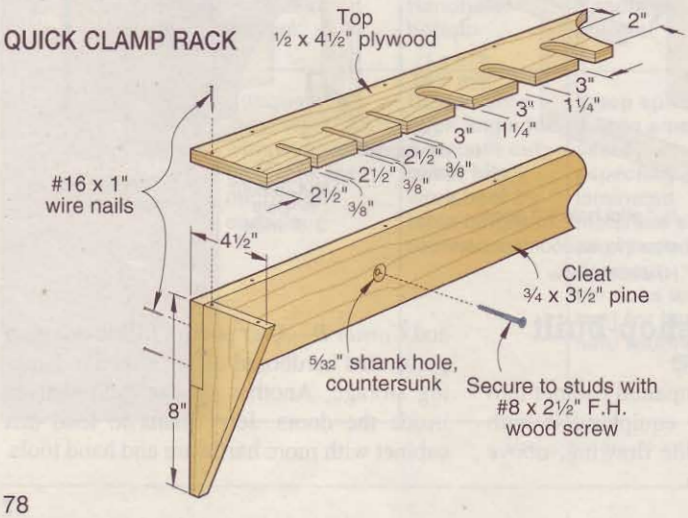
THE CURE: Wall racks cradle clamps

Enclosing half of the doorway with a 4'-wide wall gives the shop a finished look and provides the backdrop for a bevy of clamp racks (see *Corner C—After* photo). The clamps used to hang on the opposite end of the shop, a long way from Jerry's workbench.

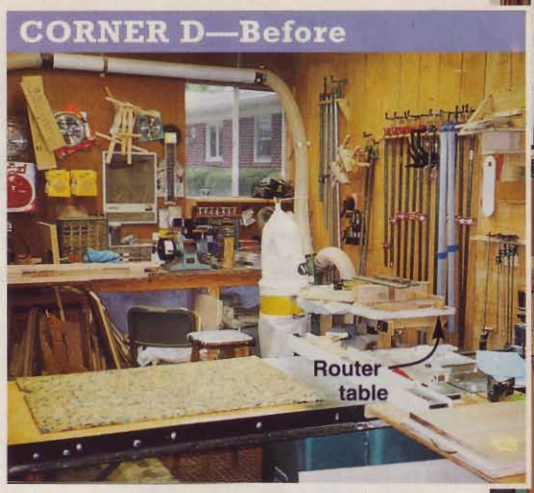
We moved what clamp racks he had, plus built a few more, like the ones shown in the drawing *below left*. Both styles are constructed the same way. The difference lies in the size and spacing of the slots. One rack holds pipe clamps, the other keeps rapid-action bar clamps.

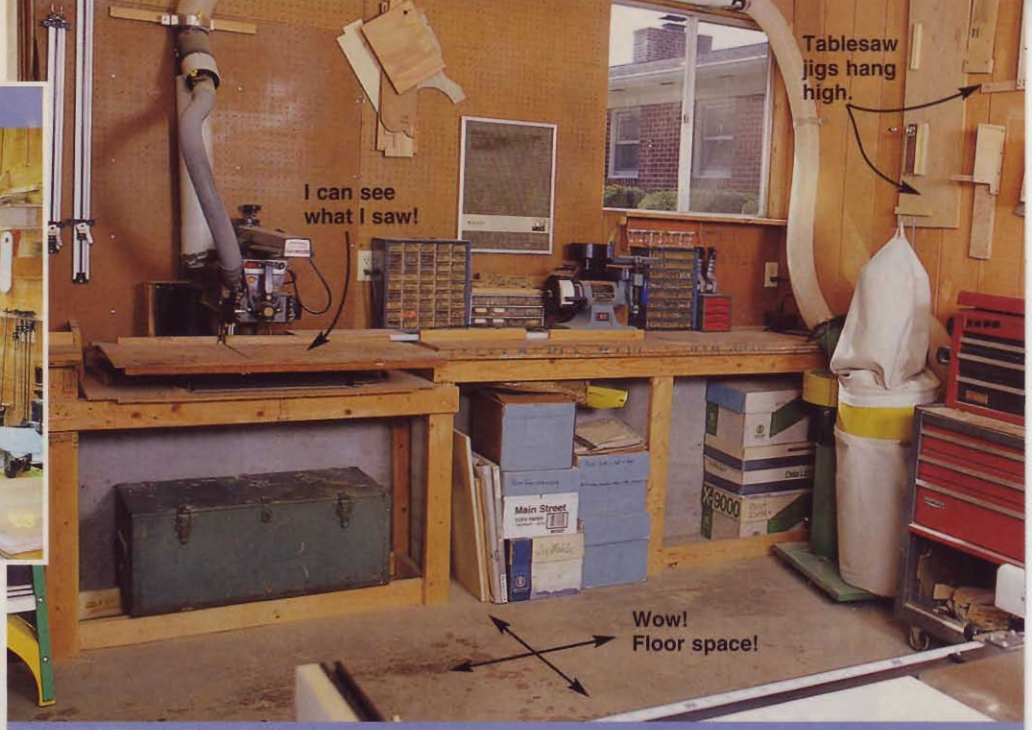
THE SICKNESS: An unmovable tablesaw doubles as a dumping ground

Jerry's 3-hp cabinet saw with a 52" fence earns its keep at the center of the shop. But positioning it there effectively chops the workspace into two separate rooms. At least the tablesaw became a convenient tabletop and workbench—meaning it easily got buried!



Techniques Editor Dave Stone adjusts the new mobile base that makes Jerry's massive tablesaw moveable.





Ditching the freestanding router table made space for a tool box. The dust collector tucks tight to the wall and turns on by remote control. Tablesaw jigs hang on the wall within reach.

THE CURE: Making the saw mobile cuts out hassle

Mounting a universal mobile base under the saw allows Jerry to move this heavy machine by himself if the need arises. That way he can position it for cutting big boards or get it out of the way altogether to increase floor space.

THE SICKNESS: A router table wastes space

In the *Corner D—Before* photo, you'll see that one wall on the infeed side of Jerry's tablesaw was consumed by clamps. Some of the longer clamps forced him to position his router table away from the wall in the already inadequate floor space.

THE CURE: An all-in-one sawing and routing station works wonders

We got rid of the stand-alone table and replaced it with a router-table-equipped extension wing for the tablesaw. This full-function table ate the biggest single chunk of our budget (detailed in "Where the money went" at *bottom right*), but upgraded both Jerry's tablesaw and his routing capabilities in addition to opening up space.

Of course, we didn't let the space we created go to waste. We parked Jerry's rolling tool box along the newly cleared wall where it interfered least with other shop tools. Then we surrounded the toolbox with Jerry's many tablesaw jigs. They now hang on screws where they belong, on the infeed side of the saw where Jerry can reach them easily as he works (see *Corner D—After* photo).

The final diagnosis

So, did our cures rid Jerry's shop of its sickness? Here's what Jerry had to say: "I knew that I wasn't very organized, but I didn't realize what a difference more storage and mobility could make. I find it hard to believe how much better the shop functions, and so does everyone who comes by to see my workshop workover."

Jerry has learned that anyone can get his or her workshop organized. It just takes forethought, a few well-spent dollars, and a little help from woodworking friends. Who knows, your shop might be next. If you're interested, send a letter (200 words or fewer) explaining why your shop needs a workover, along with a floor plan sketch, and up to five photos. See our address on *page 8*.

Written by **David Stone** with **Kevin Boyle, Chuck Hedlund,** and **Jeff Mertz**
Photographs: **Gayle Harper**, In-Sight Photography

An integrated router table makes the tablesaw multi-task. Senior Design Editor Kevin Boyle makes sure it sits flush with the saw table.

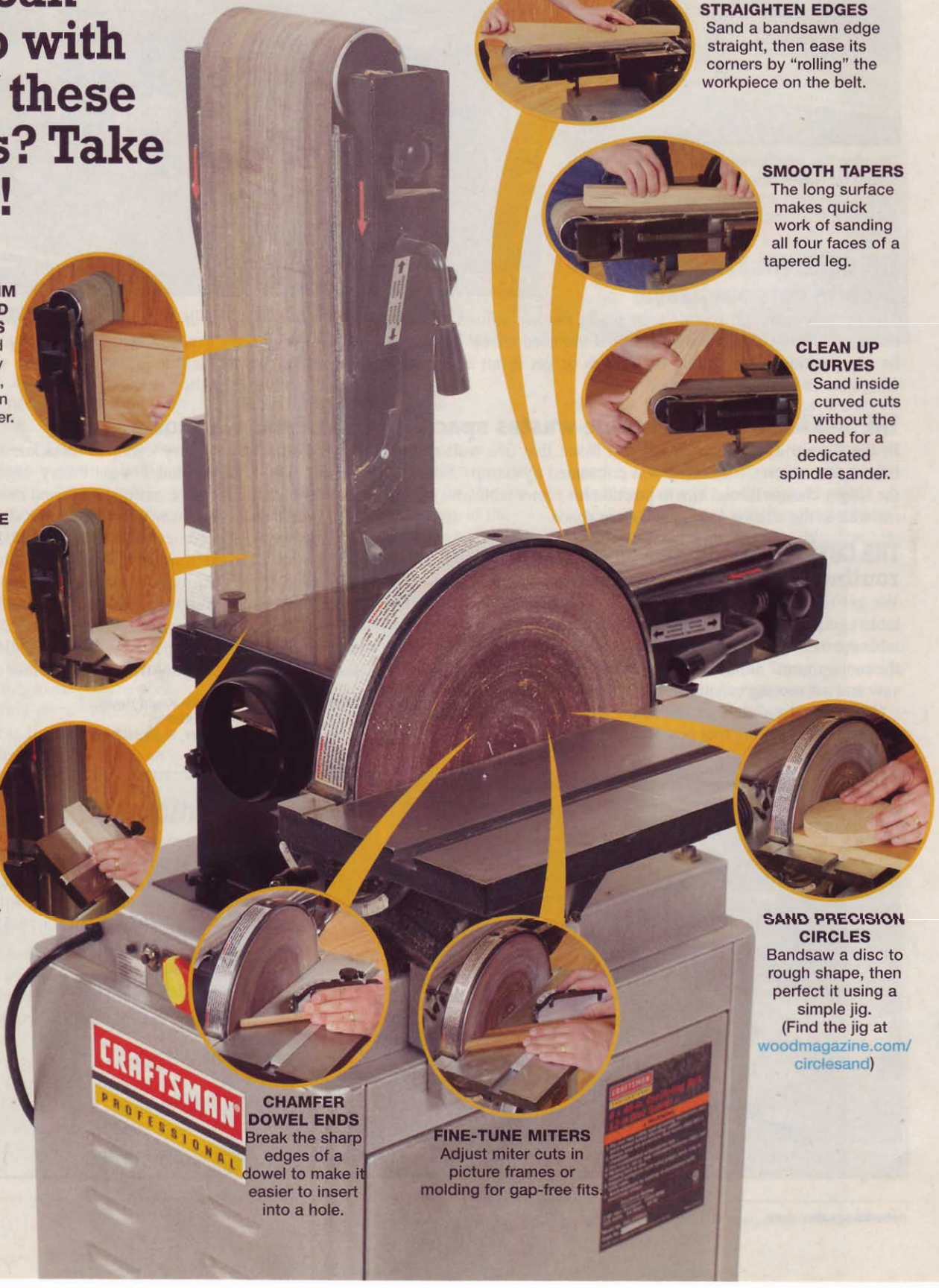
Where the money went

We set out to make major improvements without spending more than $1,000. You can see that had we not needed two big-ticket items—the router table and tablesaw mobile base—we could have cut our budget in half. Here's how we spent our money, rounded to the nearest dollar.

Tablesaw mobile base	$ 180
Router-table extension for tablesaw	$ 347
Cabinets (three 24×30", one 24×36")	$ 216
4" locking casters	$ 28
Sheet goods	$ 95
Lumber	$ 80
Hardware and supplies	$ 42
TOTAL	$ 988

6x48" belt/disc

What can you do with one of these babies? Take a look!



STRAIGHTEN EDGES
Sand a bandsawn edge straight, then ease its corners by "rolling" the workpiece on the belt.

SMOOTH TAPERS
The long surface makes quick work of sanding all four faces of a tapered leg.

CLEAN UP CURVES
Sand inside curved cuts without the need for a dedicated spindle sander.

TRIM INTERLACED JOINTS
Box joints and dovetails, typically cut a little oversize, become flush fast on a belt sander.

EASE CORNERS
Cut project parts square on a tablesaw, then radius the corners with precision.

MAKE BETTER BEVELS
Bevel pieces up to 6" wide using the tilting table.

SAND PRECISION CIRCLES
Bandsaw a disc to rough shape, then perfect it using a simple jig. (Find the jig at woodmagazine.com/circlesand)

CHAMFER DOWEL ENDS
Break the sharp edges of a dowel to make it easier to insert into a hole.

FINE-TUNE MITERS
Adjust miter cuts in picture frames or molding for gap-free fits.

sanders

These machines, priced from $400 to $800, tackle a range of sanding tasks with both power and finesse. And though they look similar, we found big performance differences among the tested models.

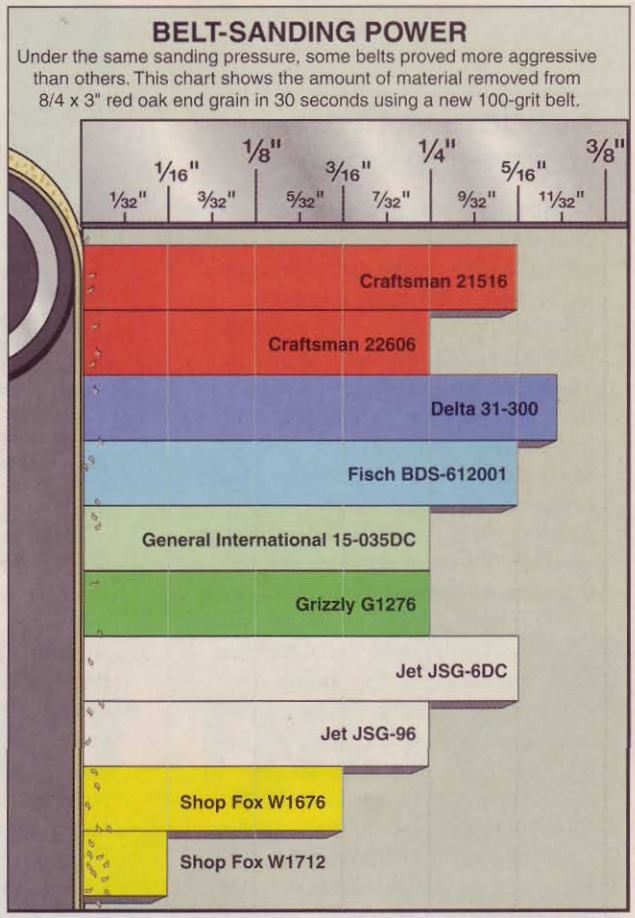
If you've never had the pleasure of using a big combination sander like the ones tested for this article, you're missing out on one of the most versatile machines in the shop. Compared to a portable belt sander clamped upside-down in a vise, it's like the difference between using a long bed jointer and a hand plane to put a straight edge on a board—it can be done, but the large, flat surface makes the job easier and faster. These sanders also sport large-diameter discs, allowing you to sand wider workpieces than less-expensive benchtop belt/disc sanders.

Five qualities that count in a belt/disc sander

1 *Power.* Don't expect a machine's rated horsepower to tell you how fast it'll hog away wood—we found little relationship between the two. To uncover their true power, we tested the sanders in two ways.

To gauge disc power, we sanded red oak end grain using identical 80-grit abrasive discs while applying first 35 lbs of pressure, then again with 12 lbs. Under the heavier pressure, the Delta 31-300, General International 15-035DC, Shop Fox W1676, and the similar Craftsman 22606 and Fisch BDS-612001 didn't bog down a bit. The other sanders slowed or stalled under heavy pressure, but performed well under the lighter load.

Next, we moved to the belt portion of the sanders. After equipping each machine with a new 100-grit belt, we again applied 35 lbs of pressure and measured how much red oak end grain each sander could remove in 30 seconds. You'll find the results in the Belt-Sanding Power chart, *above right*. Although the motors on all of these sanders turn at about 1,725 rpm, Delta's large belt-drive roller gives it the highest belt speed in the test and makes it the most aggressive, removing 11/32", followed closely by the Craftsman/Fisch and Jet JSG-6DC's 5/16". By contrast, the slow belt speed of the Shop Fox W1712 prevented it from removing more than 1/16".



2 *Sturdy, accurate tables.* Loads of power doesn't mean much if it's not paired with precision. In fact, when touching up a bevel or miter, accuracy and table stability under pressure are paramount. Belt and disc tables that mount with cast-iron trunnions (see photo, *below left*) proved rock-solid in our tests. Such machines also have separate tables for the belt and disc, saving you the inconvenience of switching one table back and forth.

The tables of two sanders—the Jet JSG-96 and Shop Fox W1676—mount to the machine by means of a steel post. We found two disadvantages to this design: First, the single stamped-steel trunnion tends to deflect and can even rotate on the post under heavy sanding pressure. Second, these tables pivot near the center of the table, instead of at the edge closest to the disc, which reduces the sanding capacity when the table is tilted, as shown in the photo *below right*.

3 *Flat disc and platen.* Again, it's a question of accuracy. So far as the disc goes, its constant turning minimizes the effect of any high spots and low spots, and the worst runout of the test, .008" on the Shop Fox W1676 disc, didn't affect its accuracy in the slightest.

TABLE TALK: CAST-IRON TRUNNIONS ARE TOPS

Cast-iron trunnions, such as on the Grizzly G1276 (left), locked tight and didn't deflect a bit, even when we really bore down on them. When the post-mounted table (right) is tilted, the leading edge moves up and away from the disc, narrowing the available sanding area.

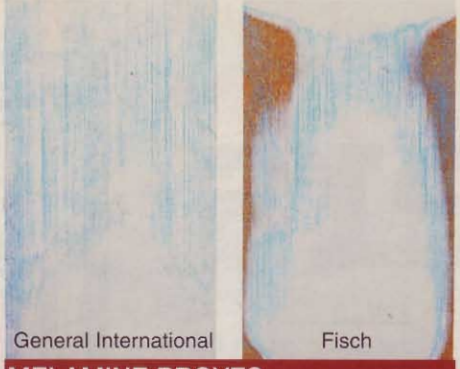
Sanders with an innovative edge

Combination sanders as a group have changed little over the last few years, so we're glad to see some thoughtful innovation in the tools we tested. Besides the onboard dust collection on the General International 15-035DC and Craftsman 21516, here are two other features new to combination sanders:

■ *Oscillating belt.* The abrasive belts on some large commercial edge sanders go side-to-side while they go around. The extra movement helps the abrasive last longer and reduces burning from sandpaper loaded with dust and wood pitch. You'll find this same oscillating action on the Craftsman/Fisch sanders. With the oscillation feature engaged, the belt tracks left and right ¾".

■ *Oscillating spindle sander.* Talk about your do-it-all sanding machine, Craftsman placed an oscillating spindle sander smack between the belt and disc on its 21516 model, and threw in variable speed to boot. With the oscillating spindle, you can sand inside tight curves, and even smooth the edges of a hole. Though not quite as powerful as the best sanders in the test, it performed at or above average on belt, disc, and spindle.

The oscillating spindle sander on the Craftsman 21516 has a ⅝" stroke and oscillates 60 times per minute.



MELAMINE PROVES PLATEN FLATNESS

Areas untouched by the belt (white) point to a low spot on the platen. Blue chalk indicates where the abrasive grit made contact. Brown areas show high spots on the platen.

If you sand the face of a wide workpiece on the belt, though, can you trust the machine to make it truly flat? That quality originates with the *platen*—the supporting surface behind the belt. To quantify platen flatness, we fired up each sander and placed a weighted piece of melamine-coated particleboard on its belt for 10 seconds, and then noted the consistency of the scratch pattern. The photo, *above*, shows the best and worst of the tested models.

Six of the sanders came from the factory with a graphite pad adhered to the platen, which the manufacturers say makes the belt run smoother and quieter. We didn't observe any significant difference between graphite-padded platens and nonpadded platens in that regard. We did find, however, that sanding end grain on a graphite pad tends to compress it at the table level, creating a pronounced dip in the graphite.

4 *Easy belt changes and adjustments.* Changing belts on a combo sander involves removing parts, such as the belt table, guards, and/or dust collection ports, and those that don't require any tools for the task earned an "A" grade in the chart on *page 84*.

All of the sanders have a quick-release system to relax the belt tension when belt-changing time comes, and on most units, the mechanism locks in the untensioned position. This frees both hands for changing the belt, and allows you to detension it to prevent stretching when the sander won't be used for awhile. The tension-release lever on the Grizzly and Jet JSG-6DC must be held down with one hand while you slip the belt off with the other, and on the Jet that takes a lot of strength.

5 *Efficient dust collection.* These machines remove a lot of material fast, and without proper dust collection, the shop air quickly becomes hazy with super-fine wood particles. Most of the sanders in this test performed adequately when connected to a dust collector, but two machines did very well *without* an external dust collector. Both the Craftsman 21516 and the General International (shown *below*) have dust blowers and filter bags built in, so you can use them anywhere without worrying about making a dust-collection connection. Of the remaining sanders, we favor those with a single 4" dust-collection port that draws from both the belt and disc versus units with two ports that require switching the hose or hooking up a wye.

CONVENIENT DUST CONTROL

General International's internal dust collector has its own motor, power switch, and a 5-micron filtration bag inside.

WOULD YOU STOOP TO THIS?

The low tables on the Craftsman/Fisch sander can test your back, especially when tilted down for sanding miters.

Everything you need to know about the tested tools

Craftsman 21516, $470
Visit Sears or craftsman.com

High points
- This multifunction machine also includes an oscillating spindle sander.
- Built-in dust collector works well on belt, disc, and spindle, and an integral blast gate directs suction to the sander in use.
- Variable-speed control allows you to choose the best belt/disc/spindle speed for the task.
- Belt sander arm changes easily from horizontal to vertical and back.

Low points
- Although you can shut off the spindle sander when using the belt or disc, you can't stop the belt and/or disc when using the spindle sander.
- Disc sander bogs down under heavy pressure, but did fine with lighter pressure.
- No belt guard on end roller, leaving you unprotected with the belt arm horizontal.
- Included miter gauge is insubstantial, and miter slots in tables are too small to accept a standard miter gauge (say, from your tablesaw).
- It's a long reach from the disc to the machine's power switch.

More points
- It weighs almost as much as some stationary sanders in the test. Add the optional stand for $40.
- Three sanders in one for this price, and with good performance on all three, makes it our Top Value.

Craftsman 22606, $700 / Fisch BDS-612001, $700
Visit Sears or craftsman.com / **724/663-9072; fisch-woodworking.com**

High points
- One of the more aggressive belt sanders, and the motor doesn't stall under heavy pressure on the disc.
- No tools needed to change the belt.
- Belt can be set to oscillate ¾".
- Sturdy miter gauge with easy-to-read scale and adjustable stops at 0° and 45°.

Low points
- Changing the belt orientation necessitates removing and replacing the dust port and belt guard, and requires an open end wrench (not supplied).
- No belt guard on the end roller, which can catch on clothing with the belt arm horizontal.
- Low disc table causes stooping for average-height woodworkers, especially with the table tilted down to 45°, as shown in the photo at *left*.
- We found it difficult to calibrate the angle cursor on the Craftsman's disc-sanding table (but not on the Fisch).

More points
- Except for cosmetic differences, these sanders are virtually identical.
- Dust collection is effective on the disc and belt in either horizontal or vertical orientation, but dust hose interferes with sanding operations, and when installed on the belt port, the hose covers the power switch on the Craftsman.

Delta 31-300, $650
800/438-2486; deltamachinery.com

High points
- The most powerful and aggressive sander in the test.
- No tools needed to make all routine adjustments, including switching the belt-arm orientation. And, unlike most machines in this test, the 31-300 held its belt tracking after the switch.

Low points
- Cast-iron belt arm is heavy, and requires some strength to move from horizontal to vertical.
- Paint wears off platen and causes belt to bounce against platen. (Replacing the belt remedied most of the bouncing.)

More points
- Miter gauge not included, but ¾"-wide miter slot accepts a standard tablesaw miter gauge.
- Power takeoff can be used with optional flap sander or pneumatic drum.
- A strong performer in virtually every area makes the 31-300 our Top Tool for this test.

General International 15-035DC, $800
514/326-1161; general.ca

High points
- Nearly as powerful as the Delta 31-300 when sanding on the disc, with an average stock-removal rate on the belt.
- Built-in dust collector with 5-micron filter bag does a superb job on both belt and disc, and makes it an attractive choice for users without a dedicated dust-collection system.
- In addition to the typical parallel-running miter slot, the disc table also has a slot perpendicular to the disc face for use with a circle-sanding jig.

Low points
- The belt arm must be held horizontally while you tighten it because there's no stop to prevent it from overrotating, and it secures with a hexhead wrench.

Grizzly G1276, $440 — 800/523-4777; grizzly.com

High points
- Cast-iron trunnions on the belt and disc tables lock solidly.
- Belt sander changes easily from horizontal to vertical and back.

Low points
- Under heavy sanding pressure on the disc, we were able to stall the motor.
- Tension-release mechanism must be held open to remove the belt.
- No dust-collection port on the disc, and the 3" port on the belt is an odd size.
- Belt-tracking adjustment instructions aren't clear in manual. Using both tracking-adjustment knobs proved cumbersome, and we were just as successful adjusting only the front knob.

More points
- This sander is one of only two benchtop models in the test.

Jet JSG-6DC, $800 — 800/274-6848; wmhtoolgroup.com

High points
- Good power when sanding on the disc, and an average stock removal rate on the belt.
- Accurate miter slot accepts a standard-size miter gauge.

Low points
- Belt tension release mechanism takes a lot of strength to operate, and must be held open to remove the belt.
- Graphite pad on platen wore unevenly from end-grain sanding, leaving a dip in the pad just above table height.

More points
- Optional flap sander or pneumatic drum adds versatility to this machine.
- A good performer at a premium price.

Jet JSG-96, $480 — 800/274-6848; wmhtoolgroup.com

High points
- Good dust collection with a single 4" port and blast gates to direct suction to the sander in use.
- Lower disc guard is a hinged door, making this the easiest sander for changing abrasive discs.
- In addition to the typical parallel-running miter slot, the disc table also has a slot perpendicular to the disc face for use with a circle-sanding jig.

Low points
- When placing heavy sanding pressure on the disc, we were able to stall the motor.
- Post-mounted disc table deflected under sanding pressure and, when tilted down to 45°, reduced the capacity of the sanding disc (see photo on *page 81*), already the smallest in the test at 9".

More points
- Clockwise disc rotation is opposite of most *disc sanders and takes some getting used to.*
- Also available in an open-stand version for $400.

Written by **Dave Campbell** with **John Cebuhar**

MAKING THE ABRADING GRADE:

BRAND	MODEL	MOTOR: RATED HORSEPOWER	MOTOR: VOLTAGE	SPEED (1): DISC (RPM)	SPEED (1): BELT (FPM)	BELT SANDER: TABLE SIZE (W x L, INCHES)	BELT SANDER: TABLE MOUNTING METHOD (2)	
CRAFTSMAN	21516	1 1/2	110	643-3,675	488-2,780	6 x 9 1/2	T	
	22606	1 1/2	110/220	2,306	1,802	6 x 10 1/8	T	
DELTA	31-300	1 1/2	110/220	2,204	3,162	7 x 16 3/8	T	
FISCH	BDS-612001	1 1/2	110	2,298	1,800	6 x 10 1/8	T	
GENERAL INTERNATIONAL	15-035DC	1 3/4	110/220	1,791	2,335	6 13/16 x 12 9/16	T	
GRIZZLY	G1276	1	110/220	1,784	2,327	7 x 16 3/8	T	
JET	JSG-96	3/4	110	1,787	2,342	5 1/2 x 11	T	
	JSG-6DC	1 1/2	110/220	1,794	2,324	7 5/16 x 14 3/16	T	
SHOP FOX	W1676	1	110/220	2,402	1,912	6 1/8 x 12 3/8	P	
	W1712	1 1/2	110	1,794	1,114	8 x 12 1/8	T	

NOTES:

1. Measured under no load with phototachometer.
2. (P) Post
   (T) Trunnions
3. (A) Aluminum
   (C) Cast iron
4. (C) Cast iron
   (C/G) Cast iron with graphite pad
   (S) Stamped steel
   (S/G) Stamped steel with graphite pad
5. (*) *Built-in dust collector; no external* dust collection ports
   (1) Single port pulls from belt and disc
   (1**) Single port pulls from belt sander only
   (2) Seperate ports for each sander

Share your opinion of these sanders in our Interactive Tool Review at **woodmagazine.com/combosander**

Put your money on these sanders

Because the belt and disc of the Delta 31-300 proved unstoppable in our tests, and because all routine adjustments could be made without tools, we named it Top Tool. True, it doesn't come with a miter gauge—an accessory that's found on every other sander in this price range—but its standard-size T-style miter slot readily

Shop Fox W1676, $400
800/840-8420; shopfox.biz

High points
- Closed base has shelf for extra storage of sanding supplies.
- The least expensive combination sander in the test.

Low points
- A single table must be moved from belt to disc and back. Post-mounted table deflects under sanding pressure and, when tilted down to 45°, reduces the capacity of the sanding disc, already limited at 10".
- With belt removed and arm horizontal, idler (end) roller can fall onto the floor.
- Tight quarters make it difficult to get a wrench on the arm-locking bolt for moving belt to horizontal from vertical and vise-versa.
- Odd-size dust port on belt.

Shop Fox W1712, $495
800/840-8420; shopfox.biz

High points
- Largest disc table in test, and the longest belt platen.
- Noticeably quieter than the other tested machines.
- Easy-to-read miter gauge marked in 1° increments.

Low points
- Slow belt speed makes this the least aggressive sander we tested.
- Plastic guards on belt and disc tend to drag on the abrasive.
- Odd-size dust ports.

More points
- Dual steel trunnions lock on both sides, and deflected less than a single steel trunnion, but more than cast iron.
- Like other steel-trunnion tables, it pivots from the center and reduces capacity when tilted down. At 45° downward tilt, edge of table nearest disc moves 9/16" away from disc.

TEN COMBINATION SANDERS PRICED FROM $400 TO $800

				DISC SANDER			DUST PORTS	PERFORMANCE GRADES (6)											ACCESSORIES (8)						
TABLE MATERIAL (3)	PLATEN LENGTH (INCHES)	PLATEN MATERIAL (4)	DIAMETER (INCHES)	TABLE MOUNTING METHOD (2)	TABLE SIZE (WxL, INCHES)	NUMBER OF PORTS (5)	DIAMETER (INCHES) (6)	POWER UNDER LOAD	BELT TABLE QUALITY	DISC TABLE QUALITY	BELT PLATEN FLATNESS	BELT TRACKING	DUST COLLECTION EFFECTIVENESS	EASE OF CHANGING BELTS	EASE OF CHANGING DISCS	EASE OF CHANGING BELT FROM VERTICAL TO HORIZONTAL	MITER GAUGE QUALITY	NOISE LEVEL (db) (7)	STANDARD	OPTIONAL	WEIGHT (POUNDS)	CORD LENGTH (FEET)	WARRANTY (YEARS) (9)	COUNTRY OF ASSEMBLY (10)	SELLING PRICE (11)
C	16 3/4	S	12	T	7 x 16	*	2 1/2	C	B	B	C	A	A	A-	B	A	C-	100	M	OS, RS	200	6 1/2	1	C	$ 470
C	16 7/8	C/G	12	T	7 x 16 1/8	2	4	B	A	A	D	B	B	B	B	B	A-	98	CS, M, W	MB	197	6 1/2	1	T	700
C	14	C	12	T	9 1/8 x 16 1/8	1	4	A	A	A	B	A	B	A	B	C	N/A	94	OS	PS	306	7 1/2	2	T	650
C	16 7/8	C/G	12	T	7 x 16 1/8	2	4	B	A	A	D	B	B	B	B	B	A-	98	CS, M, W		197	6 1/2	2	T	700
C	14 3/4	S/G	12	T	9 3/4 x 16 3/8	**	N/A	B-	A	A	A	A-	A	B	B	B-	C	103	CS, M, W		299	5 1/2	2	T	800
C	14 1/2	C	12	T	7 x 16 3/8	1**	3	C	A-	A	C	B-	D	C	B+	A-	C-	95	M		155	5	1	T	440
A	14 1/2	S/G	9	P	10 x 12	1	4	C	B-	C	C	A	B	B	A-	A-	B	109	CS, M, W	MB, OS, PS	128	5 1/2	LIFE	T	480
C	14 3/4	C/G	12	T	9 x 16 3/16	1	4	B-	A	A	B	B-	B	C	B	A-	C	91	M, OS, W	CS, MB	210	5 1/2	LIFE	T	800
C	12 1/2	C/G	10	Belt table used on disc sander		2	2 and 2 1/2	C-	D	N/A	D	A	B	A-	B	C+	A-	96	CS, M, W	MB	170	10	2	T	400
C	18	S	12	T	10 x 17 5/8	2	5/16 and 2	D	B-	B-	C	B	B	C	B	A-	A	86	CS, M, W	MB	178	10	2	T	495

6. A Excellent; B Good; C Average; D Below average; N/A Sander does not come with this accessory.

7. Average of belt and disc under no load, measured from 12" away.

8. (CS) Closed stand; (M) Miter gauge; (MB) Mobile base; (OS) Open stand; (PS) Pneumatic drum sanders and extension shafts; (RS) Additional rubber spindles for spindle sander; (W) Work stop

9. (LIFE) Lifetime warranty against factory defects.

10. (C) China; (T) Taiwan

11. Prices current at time of article's production and do not include shipping, where applicable.

accepted the miter gauge from the tablesaw in our shop, and should do likewise with any tablesaw miter gauge (except for Craftsman, which are typically a little undersize). The General International 15-035DC fell short of Delta's power and user-friendliness, but its built-in dust collector makes it mighty attractive too.

You'll also find effective on-board dust collection—and an oscillating spindle sander—on the Craftsman 21516, for $180–$330 less than the Delta and General International. At that price, it may not be suitable for day-in, day-out use in a professional shop, but it's perfect for the space-starved (and budget-conscious) home shop. The 21516 is our Top Value.

gear up for glue-ups

Follow this script for perfectly aligned, rock-solid assemblies that are easy to manage.

Subassembly gluing of this nightstand uses L-shape clamping squares to ensure 90° angles. Risers hold your assembly off the workbench, allowing space for clamps.

Whether your next woodworking task is a major production or just a 10-minute skit, every project that gets rave reviews includes successful glue-ups as part of the script.

When you're gluing and clamping your part assemblies, first ready your stock. Only by working with straight, stable stock can you precisely align parts in a glue-up.

Start by acclimating your stock to the humidity and temperature of your shop. Here's how to proceed.

Acclimation stages

Stage 1: Allow rough stock to acclimate in your shop for 24 hours before milling. Aim for a 6- to 11-percent moisture content. Then mill pieces to rough dimensions, as shown in **Photo A**.

A

To prevent post glue-up warping, acclimate your project stock to your shop. Do this by standing it on edge, or resting it on stickers (wood spacers), allowing air to surround it.

Stage 2: After the initial milling, give the stock another 24 hours to acclimate again. Following this second rest, inspect your pieces to see if you'll need to flatten or otherwise adjust your stock before assembly. When satisfied, mark up your stock according to the specification in your plans, set up your tools, and machine your workpieces to size.

Planning the production

Preparing to glue up milled stock eliminates unpleasant, last-minute surprises. Use this script to ensure success:

✔ Gather the necessary clamps for the project. (In most edge-to-edge glue-ups, figure about 10" spacing between clamps.) Need more? Borrow or buy clamps as needed to provide full bonding along a glue joint.

✔Are your clamps long enough? If not, couplers or pipe extensions, such as the one shown in **Photo B** (about $2.50), will save you the expense of buying more clamps.

✔Inspect the heads and bars of each clamp. Remove dried glue globs, grit, or oily substances that dent or contaminate the project surfaces.

✔To avoid marring your finely sanded stock, each clamp surface needs a clamp pad (about $5 a pair in catalogs). Hardwood clamp blocks make an adequate substitute, but you may have trouble juggling them during the glue-up process. One solution for pipe clamps is shown in **Drawing 1**.

Enter the supporting cast

The gluing process is more than clamps. In supporting roles, be sure you have on hand:

✔Riser blocks to hold your project a few inches above the benchtop, creating plenty of room for clamp heads. Around the *WOOD*® magazine shop, we like the roominess that 4×4s afford, as shown in the photo on the previous page. You may need to run them through the jointer to make them square and flat.

✔L-shape corner clamping squares. These simple accessories guarantee 90° sides.

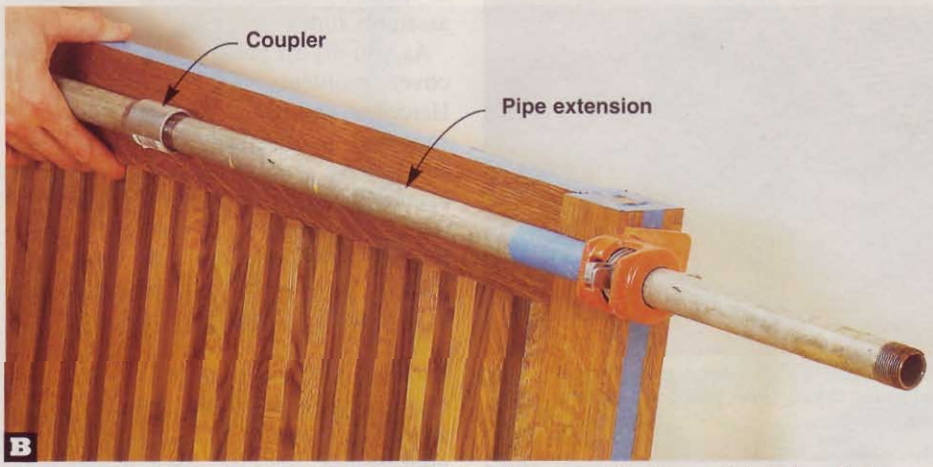
✔A dead-blow mallet and cushioning block to coax together tight-fitting joints.

✔Extended open-time glue—ideal for working with large or complex assemblies. If you can't find a local supplier, call Titebond at 800/347-4583.

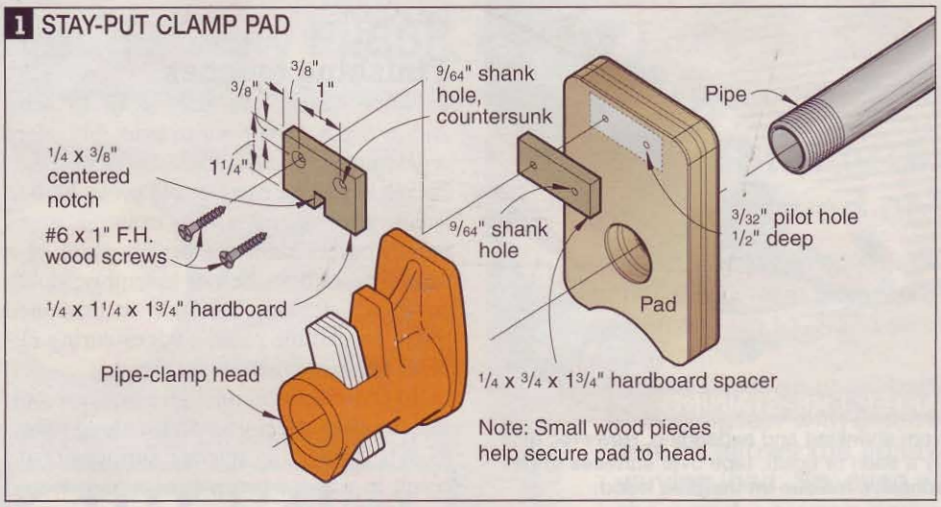
✔Cauls—stiff, sturdy boards—distribute pressure between clamps. As shown in **Drawing 2**, woodworkers rely on a slightly bowed caul for even pressure distribution. See them in action in **Photo C**.

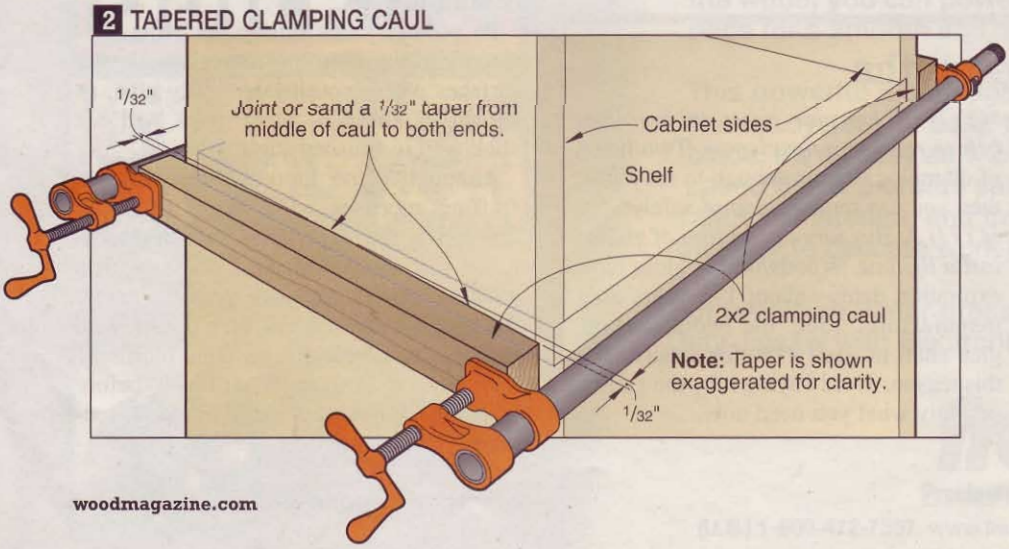
✔Waxed paper and masking tape to shield wood surfaces from clamps or dripping glue. We prefer blue (painter's) masking tape because it leaves behind no adhesive residue.

✔Plastic putty knife or rubber kitchen spatula, rags, and clean water to remove glue squeeze-out.



Add extensions to your pipe clamps for extra-long glue-ups. The blue painter's tape helps protect the wood from damage by the pipe clamps and glue.

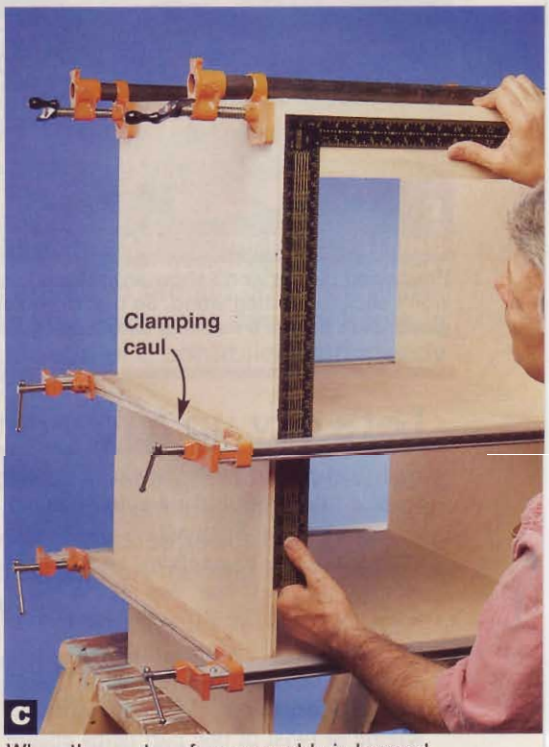



2 TAPERED CLAMPING CAUL
1/32"
Joint or sand a 1/32" taper from middle of caul to both ends.
Cabinet sides
Shelf
2x2 clamping caul
Note: Taper is shown exaggerated for clarity.
1/32"

The dress rehearsal

Before you open the glue bottle, you'll want to uncover every joinery problem, script the assembly sequence, and decide where and how to clamp.

Dry-fit your assemblies and document the steps, imagining you're applying glue



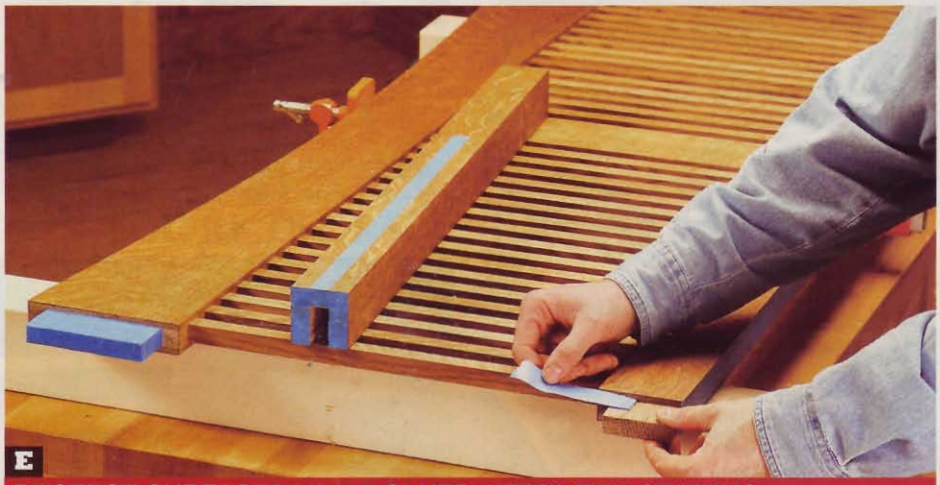
When the center of an assembly is beyond the reach of your clamps, a caul with a slight convex edge helps distribute pressure.

Measure diagonals. Equal lengths mean square corners.
Assemble on riser blocks for clamp head clearance and even air flow when you apply glue.
Distribute clamps on both sides of the assembly, eliminating twist.

D

REHEARSE YOUR ASSEMBLY

Dry-assemble your project pieces so you can double-check, and maybe even shorten, your clamping routine. Even when using glue with an extended drying time, you don't want any last-minute surprises from tight-fitting joints or mistakes.



E

PROTECT SURFACES TO BE GLUED AFTER PRE-STAINING

Prestained pieces won't show any telltale lines from shrinking and expanding. However, glue won't stick to finished wood. So before you apply a stain or finish, tape over surfaces to be glued. Blue painter's masking tape won't leave adhesive residue on the bare wood.

Let's dry up a few glue myths

Our testing of woodworking glues revealed the truth behind some popular misconceptions. Such as:

MYTH 1: *Only by applying glue to both mating surfaces can you get a good bond.* Actually, you'll get great results by spreading glue on just one side. Covering both pieces doubles the risk of excess squeeze-out. When possible, a wiggle or twist of one part helps ensure a reliable transfer of glue to both pieces.

MYTH 2: *Let glue joints sit overnight before removing the clamps.* Two hours of clamping time is enough to set joints, then you can remove clamps safely.

MYTH 3: *Buy large quantities of glue to last a lifetime.* Woodworking glues have expiration dates—about 1–2 years after manufacture. (See the woodworking glue chart in issue #156 for details.) For this reason, avoid buying it by the gallon; get only what you need now.

along the way. Clock your time. Did your run-through last longer than the open time for your glue? (Even for extended open time glues, the maximum is 20 to 25 minutes.) If so, consider these options:

- Split up the gluing process into smaller subassemblies.
- If necessary, call in extra hands to share the assembly and clamping roles.
- Rehearse the assembly process again to reduce the time. You'll be amazed at how a second or third run-through speeds assembly time.

As you dry-fit parts, you'll quickly discover problems. You shouldn't need Herculean strength or a sledge hammer to snug up a mortise-and-tenon joint. If you can't arrive at joint perfection with light clamping pressure or a couple of light taps with your dead-blow mallet, plan to remake ill-fitting parts. Clamping can't correct loose joints or mis-sized and warped parts.

With your tape measure, confirm that your assembly is square. The measurement of your diagonals should be equal as shown in **Photo D**. If not, try adjusting your clamp pressure, location, or both. Still not equal? Find out why your assembly is racked: Machining or joinery may be the villain.

Finishing touches

In some cases, you may need to stain and/or finish parts prior to assembly. Here are common examples:

- When project parts would prove hard to access after assembly. For example, many woodworkers stain the center panel of a raised-panel door before assembly; doing so avoids drawing attention to unstained wood around the panel's edges during climate changes when wood shrinks.
- In order to minimize glue squeeze-out, which could affect your finish along joints.
- When finishing interior surfaces could result in runs or brush strokes that would be difficult to fix.

To protect joints during such the pre-assembly finishing processes, mask the surfaces where you'll later apply glue, as shown in **Photo E**. Most glues will not stick well to finished surfaces.

Although some literature recommends stuffing mortises with pieces of paper towel, it's our experience that this technique can compound the problem with a wicking action that draws more finish into the mortise. We've had best results with brushing finish carefully around mortises.

Finally, if you apply a finish before assembly, follow the manufacturer's recommended curing time.

It's showtime!

Just repeat the assembly steps you rehearsed during dry-clamping—this time with glue. Apply glue to one surface, and draw together the mating surfaces.

For 20 years in our shop, we've had great results by spreading glue with ½"-wide acid brushes found in woodworking catalogs and the plumbing section of hardware stores and home centers. Another inexpensive (or free) glue spreader is the plastic core of used, disposable foam brushes, as shown in **Photo F**.

For even application, some woodworkers rave about glue bottle rollers, but they require cleaning after each use.

What's enough clamping pressure? When the wood pieces are touching and the glue starts to squeeze out, that's enough clamping pressure. If you squeeze out too much glue, you'll starve the joint and weaken it in the long run.

To prevent your assembly from twisting, allow the glue to dry while your project is supported on the workbench or other flat surface. The riser blocks help circulate air all around the assembly, producing an even drying time.

A couple of precautions will help reduce squeeze-out with mortise-and-tenon joints, and avoid the frustration of hydraulic problems created when the glue has no place to go within a tight-fitting joint. This particular messy problem makes it impossible to draw together the joint.

For starters, chamfer the tenon corners, as shown in **Photo G** and in the mission bed project story on *page 40*. Ditto for the mortise; you'll gain additional space for glue to escape by knocking off the edge of the mortise. Then apply glue on all but the last ½" of the tenon. Glue buildup within the joint will automatically cover that area.

Before walking away from the assembly, deal with the glue squeeze-out. After it skims over (glue loses its shine in a period that varies with the amount, type, and room temperature), remove glue puddles with a spatula or plastic putty knife. Then dampen a rag in clean water, and remove excess glue. If you miss a spot, some types

F

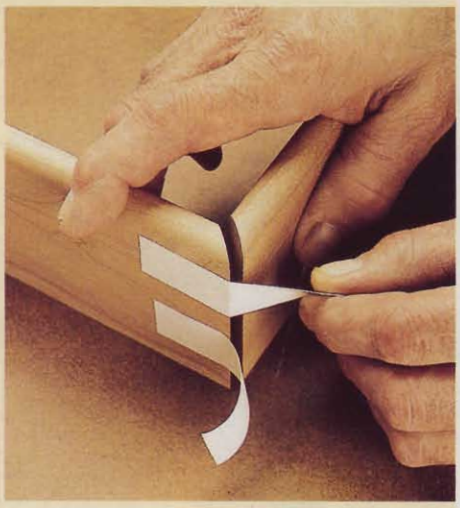
Save those worn disposable foam brushes. Strip off the foam to expose the plastic backing, which makes a perfect glue spreader.

Clamping with tape

For some projects—such as boxes and small frames—masking tape can handle chores too tiny for even the smallest clamps. You can use this on standard four-sided projects, such as the one shown to the *right*. It also works for small hard-to-clamp projects, such as an octagonal box. Here's how:

First lay the box pieces so that the top or bottom is aligned against a straightedge with outside corners touching. Tape the pieces, as shown at *bottom, left*.

Apply glue, and roll the segments around the base, as shown *bottom, right*. Finish by taping the beginning and end segments, and allow the assembly to dry on a flat surface.



TAPE SAVES THE DAY FOR MULTI-SIDED BOXES

G

Using a block plane or sanding block, chamfer the edges of a tenon so it slides easily into the mortise during the glue-up.

of dried glue can be loosened with a dab of xylol or toluene. With porous-grain woods such as red oak and ash, be careful that you don't force glue into the pores. To avoid transferring glue to other surfaces, change rags frequently.

If you haven't yet applied finish, don't make the mistake of hurrying to sand freshly glued, unfinished surfaces. Water-based glues—including all the yellow glues—will temporarily swell the surrounding wood. Sand too soon, before the glue dries completely, and you'll wind up with a long, hard-to-fix recess once the wood fibers dry and shrink.

Before you apply stain or finish, wipe down all surfaces with naphtha to reveal glue blemishes you'll need to remove.

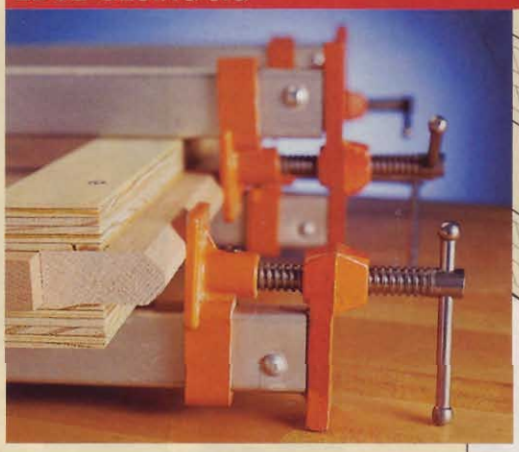
2 simple jigs for flatter, quicker glue-ups

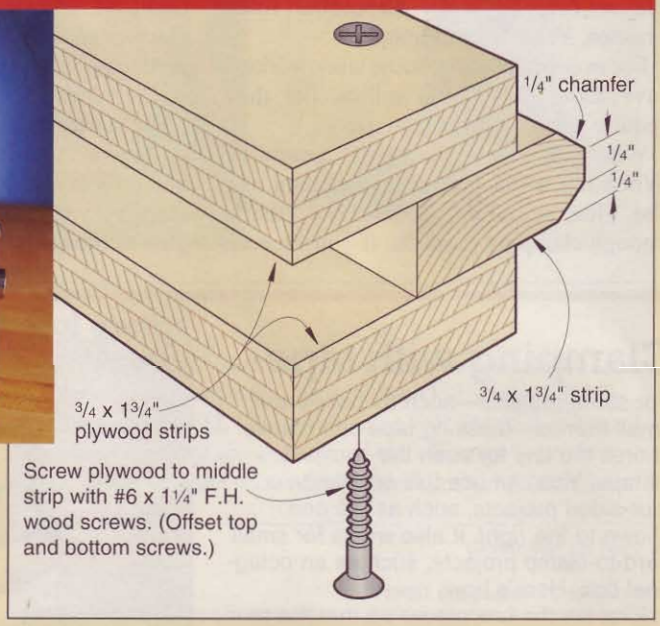
Sure, you could fiddle with odd scraps for clamp blocks, but these quick-and-easy jigs will make glue-ups go more smoothly.

■ For edge-glued projects, cut a scrap from the same thickness of stock you'll be gluing and sandwich it between two long strips of ¾" plywood, as shown at *right*.

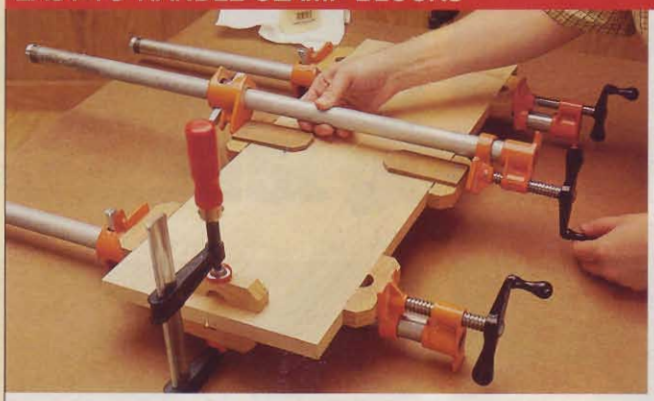
■ Screwing hardboard tabs onto U-shape clamp blocks, as shown *below*, helps you hold the blocks in place while arranging clamps for a glue-up. The tabs also provide a resting place for the clamp bars to keep them off the glue-up, while the blocks without the tabs distribute clamping pressure across a wider area than the opposing clamp jaws alone.

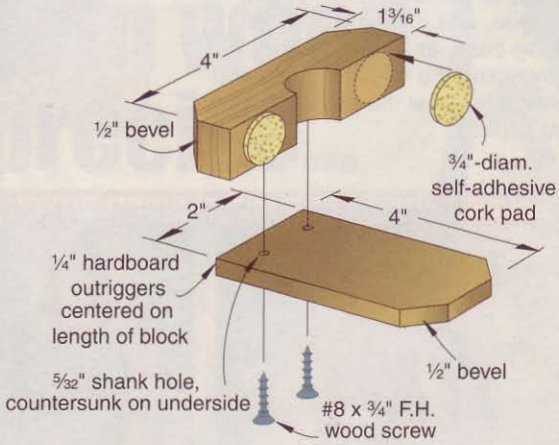
EDGE-GLUING JIG

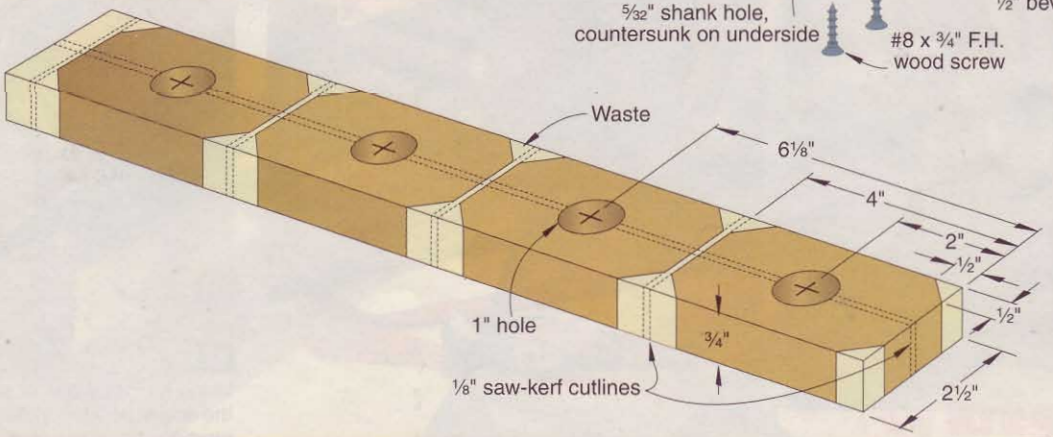



¼" chamfer
¼"
¼"
¾ x 1¾" plywood strips
¾ x 1¾" strip
Screw plywood to middle strip with #6 x 1¼" F.H. wood screws. (Offset top and bottom screws.)

EASY-TO-HANDLE CLAMP BLOCKS







ask wood

Answers to your questions from letters, e-mails, and WOOD Online®

Making the grade on abrasives

Q: At a woodworking show I bought some sandpaper in the grit numbers I normally use, but the abrasives didn't match the texture of the products from my local supplier. I think the sandpaper I bought is imported. Does that make a difference?

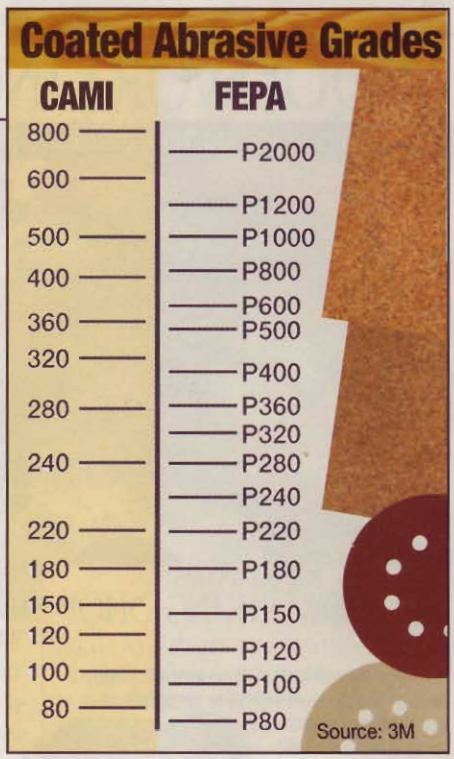
—Neal Harrison, Blacksburg, Va.

A: Coated abrasives (the technical name for sandpaper) follow one of two common grading systems used in North America: CAMI (Coated Abrasives Manufacturers Institute) and FEPA (Federation of European Producers of Abrasives).

FEPA products are sometimes called "P grade" because that letter prefixes the grit number on the back of the sandpaper, as shown at *right*. If there's no prefix, you can assume that it's a CAMI-graded product. As you can see in the chart at *right*, particle sizes in the two systems closely parallel each other up to about 220 grit; then FEPA numbers increase rapidly. If there is a letter *after* the number, it refers to the weight of the paper or fabric.

The "P" prefix by the grit number means this coated abrasive conforms to the FEPA grading system.

Manufacturers may use one or both systems for various lines of abrasives. For example, Klingspor uses the FEPA scale exclusively, while 3M uses both scales.



A second key difference is that the CAMI standards permit greater variation in particle sizes used within each grade. That may be the texture difference you noticed.

Continued on page 94

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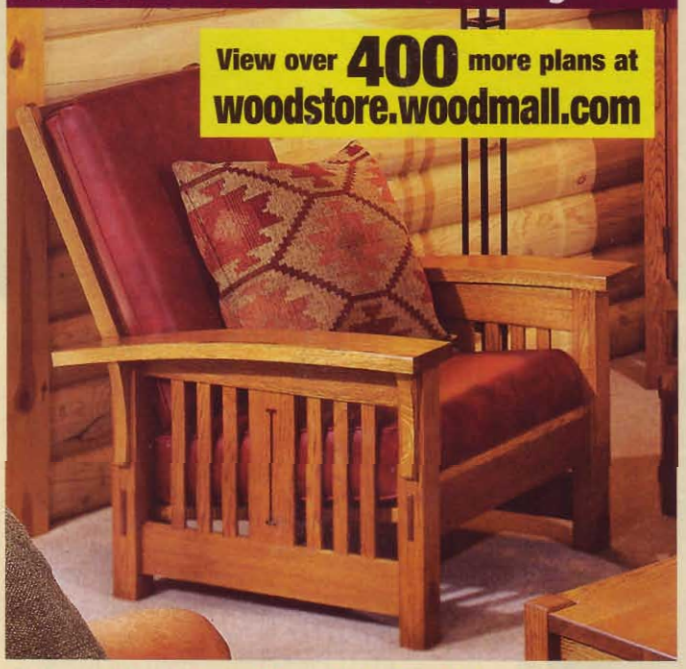
From the Editors of WOOD® Magazine



Arts-and-Crafts Collection Morris Chair Woodworking Plan

Believed to have originated with William Morris, father of the English Arts and Crafts movement, the so-called Morris chair combines comfort with simply stated good looks. True to form, our version features loose cushions, curved arms, and an adjustable back. We even show how to make the cushions. All of our detailed plans include step-by-step instructions, materials list, cutting diagram, how-to photography and woodworker-friendly drawings. **MD-00093 $13.95**

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WD1004

Taming a bucking drill press

Q ■ While helping a friend with a project in his shop, I was ■ amazed by the quiet, smooth running of his drill press. It made me realize that the vibrations in my machine may be causing the less-than-perfect results I typically get. How can I improve my drill press performance? It's a standard belt-drive floor model.

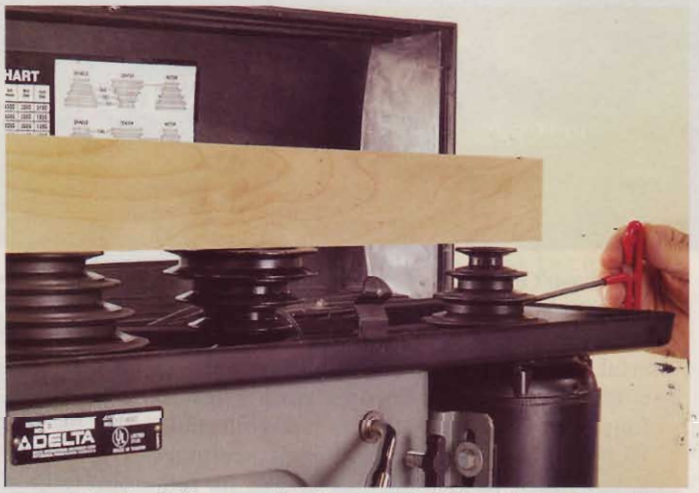
—Fred Stein, Atchison, Kan.

A ■ You're on the right track, Fred. Reducing vibration will ■ make your drill press last longer and give you more precisely rounded holes. Misaligned pulleys or worn-out belts are the prime suspects, so here's how to deal with both problems.

Unplug the drill press, and pop open the lid that conceals the pulleys. Here, you may find black dust: rubber particles that used to be part of the drive belts. To check for excess wear in the thickness and width of each belt, remove the belts and slowly run them between your thumb and forefinger. If you notice any irregularities, buy replacement belts at your local auto-parts store or from a tool supplier. We don't recommend using a belt dressing. This might also be a good time to replace your standard V-belts with link belts made from interlocking segments. These won't form humps when left curved around pulleys for long periods.

With the belts still removed, plug in the drill, and switch it on to check that the motor runs smoothly and the drive pulley doesn't wobble. Replace the motor if the bearings have worn to the point where the shaft wobbles. Replace the pulley if it has been worn or damaged by a misaligned belt.

The next step is aligning the pulleys so the belts run in a straight horizontal line. In many drill presses, you can adjust the height of only the drive pulley. To do this, raise the motor by loosening the bolts through its base or merely adjust the vertical position of the pulley on the motor shaft, as shown in the photo *below*.



A straightedge helps you align the height of the drive pulley on the motor with the center pulley, called the idler pulley because it transfers energy from the motor to the drill shaft.

Got a question?

If you're looking for an answer to a woodworking question, write to **Ask WOOD, 1716 Locust St., GA-310, Des Moines, IA 50309-3023** or send us an e-mail at **askwood@mdp.com**. For immediate feedback from your fellow woodworkers, post your question on one of our woodworking forums at www.woodmagazine.com.

shop-proven products

These woodworking wares passed our shop trials

Two contractor-style tablesaws under $550

For about the same price as a high-end benchtop tablesaw, you can have your choice of two full-blown contractor-style saws: Grizzly's G0444 or G0444Z. The G0444Z, shown at *right*, sports top-dollar features, such as a 2-hp motor, cast-iron extension wings, a stout miter gauge with adjustable-width bar, and a 4" dust-collection port.

This saw had plenty of power to cut anything I threw at it, including 2"-thick white oak, with barely a complaint. Although it comes from the factory wired for 220-volt operation, the G0444Z can be rewired easily for a 110-volt circuit. (Due to the high amperage at the lower voltage, you'll need to dedicate a 20-amp breaker to it.)

I found the aluminum fence well-built and easy to align with the miter slot, and I didn't observe any deflection in my tests. T-slots on both fence faces make it easy to attach jigs or a sacrificial face.

The G0444Z almost delivers on its promise of the "ultimate" contractor-style saw, save for two things: The large handwheels for adjusting blade height and tilt crowd the underside of the table, so I banged my knuckles on every turn. Secondly, the throat-plate insert spells out "Grizzly" in letters that sit flush with the tabletop. Cool to look at, but I soon discovered that a workpiece passing over the insert would sometimes catch on the edge of a letter.

For $90 less, you could buy the scaled back version of the "Z" saw, the G0444. The money saved earns you a clearly less-powerful 1½-hp motor and stamped steel extension wings (which I had a dickens of a time leveling to the tabletop). I also had difficulty aligning—and keeping aligned—the blade to the miter slot.

Truthfully, the G0444 is no better or worse than some $600 saws I've seen, so it's still a good deal. But I'd put my money on the G0444Z.

—Tested by Pat Lowry

Grizzly 10" contractor-style saws

G0444Z (2 hp, cast-iron wings)

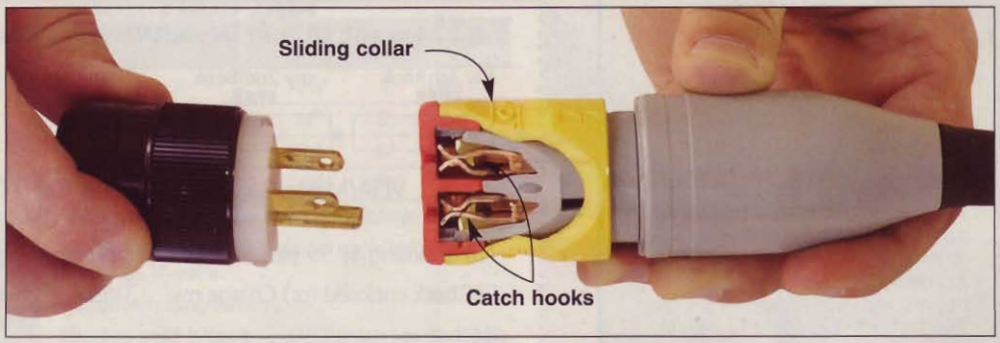
Performance	★★★★☆
Price	$525

G0444 (1½ hp, steel wings)

Performance	★★★☆☆
Price	$435

Grizzly Industrial
800/523-4777; grizzly.com

Don't tie those power cords, Qwik-Lok 'em



Don'tcha hate it when the power tool you're working with—whether a drill, sander, shop vacuum, or leaf blower—comes unplugged in the middle of the job? If you're like me, you quickly learn to tie the tool's power cord and an extension cord in a knot, but that practice is bad for both cords. Replace the female end of your extension cord with a Qwik-Lok electrical connector, and power cords disconnect only when you want them to.

This cord lock works like the quick connectors on pneumatic tools: Push the male plug into the female socket until it clicks and the two become inseparable. (I pulled as hard as I could on the junction, and stopped because I thought I might actually tear the cord of my shop vacuum from its plug.) To unlock the cords, pull back on Qwik-Lok's sliding collar and the plug pulls right out.

Curious about the tenacious grip Qwik-Lok provides on electrical plugs, I cut into the socket and discovered a pair of catch hooks that latch into the holes on the plug prongs found on most power tools. (See photo, *above*.) Pulling back on the collar releases those hooks.

The beefy, bullet-shaped body of Qwik-Lok makes it comfortable to use, but also adds another benefit: it tends to slide past obstacles, rather than hanging up on them.

—Tested by Larry Christensen

Qwik-Lok locking 120V connector

Performance	★★★★★
Price	$17

Qwik-Lok Ltd.
866/794-5565; qwiklok.com

Continued on page 100

This router accessory helps you cope

If you've worked much with baseboard molding, you probably already know that coped corners (cutting one side of the joint to match the contour of the mating piece of molding) is smarter than mitering them. Coped corners fit better than mitered ones, and the coped piece holds the noncoped piece down. Unfortunately it takes practice and patience to cut the cope cleanly with a coping saw and shape it with a rasp. However, with The Coper, you now can cut perfectly matching copes quickly using a router and flush-trim bit.

The Coper consists of two-part casting resin and a mold (*left* photo), and a base that supports the router and clamps the molding for cutting (*right* photo). Skeptical about its capabilities, I challenged The Coper with 5⅜"-tall poplar base molding with an integral ogee cap separated from the rest of the base by a narrow 3/32" reveal. After creating a pattern of the molding's profile using the casting resin, which hardens in 30 minutes, I installed my pattern in the base. (You get enough casting resin with the kit to make about ten patterns.)

With the molding-to-be-coped clamped into the base, I simply routed the cope using the included ¼" flush-trim bit with its bearing riding against the pattern. The result was perfect, except that I had to chisel out the ⅛"-radius fillet left by the bit in one inside corner.

The Coper works with any flat-mounted trim up to 1" thick and 6" wide—baseboard, chair rail, quarter-round—and the detail it picks up is impressive. (Sorry, it doesn't work with crown molding.) You can even "back cut" the molding slightly to accommodate out-of-square corners by placing a thin shim under the molding before cutting.

—Tested by Jan Svec

The Coper

Performance	★★★★★
Price	**$115; casting-resin refill, $11**

The Coper Corp.
403/381-4461; thecoper.com

Continued on page 104

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Circle No. 310

shop-proven products

Lighten up and cut the cloud of dust

A woodworking shop can never have too much space, light, or clean air. Delta's AP100 air-filtration system does something about all three by building in fluorescent lighting to this compact unit. Rated to move 400 cubic feet per minute of dirty air through its 5-micron filter, it packs enough airflow to keep the air in my 12×20' shop clean and recirculating.

The AP100's triangular shape permits hanging the unit by chains from only two points, while traditional box-style air cleaners hang from a more stable four points. The airflow was sufficient to set the whole unit gently swinging back and forth over my bench—a minor irritation.

Over the bench, the AP100's two 15-watt fluorescent tubes didn't supplement my existing shop lighting much, but I found the perfect place for the unit: over my sanding station. There it provides decent task lighting and air filtration where I need it most. It also minimizes the impact (mostly on my forehead) of the 20"-tall cabinet, which hangs about 8" lower than typical ceiling-hung air-filteration systems.

One advantage the AP100 has over those boxy steel units is portability. The built-in carrying handle, triangular shape, and soft corners make it easy to take onsite for home-improvement projects.

—Tested by Larry Christensen

AP100 Air Cleaner and Work Light

Performance	★★★★☆
Price	$180

Delta Machinery
800/438-2486; deltamachinery.com

at your **service**

Below are labels you can copy for the spice bottles and bin tops of the "Tilting-Bin Spice Cabinet" on *page 50*. Along with labels for 30 common spices, we've included four blank spaces for making labels for your own special seasonings.

Allspice	Italian Seasoning	Peppercorns
Basil	Mustard Seed	Poppy Seed
Bay Leaves	Nutmeg	Rosemary
BBQ Spice	Onion Powder	Sage
Cayenne Pepper	Oregano	Sesame Seed
Celery Salt	Paprika	Tarragon
Chili Powder	Parsley	Thyme
Cilantro		
Cinnamon		
Cloves		
Cumin		
Dill		
Fennel		
Garlic Powder		
Garlic Salt		
Ginger		

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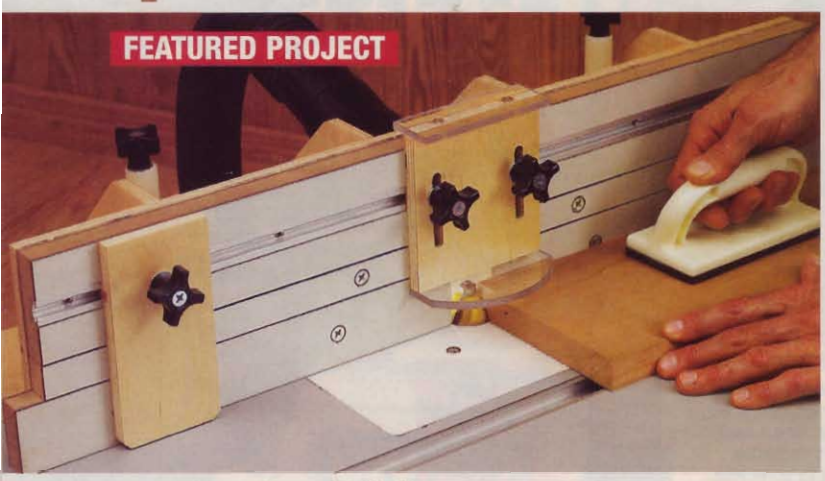
what's ahead

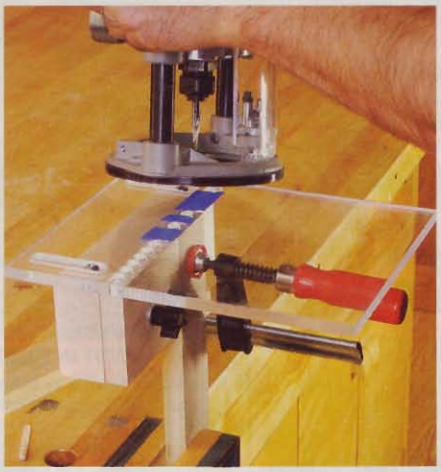
Your preview of the November issue (on sale October 12)

Special issue: make the most of your router



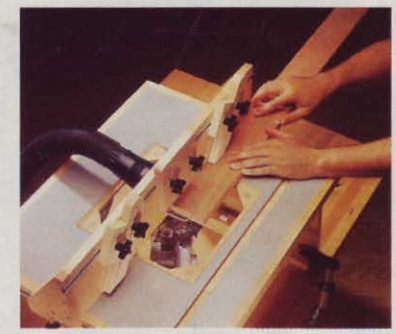
The Ultimate Router Table Fence

No matter what type of router table you have, chances are it would benefit from a better fence. This one has the features and accessories to do it all—with precision.



3 Router Experts' Best Tips and Jigs

Tap into the collective wisdom of Patrick Spielman, Pat Warner, and Carol Reed for quicker, more precise routing.



How to Smartly Choose a Router Table

Looking for your first router table or considering an upgrade? From simple to deluxe, here are your choices and what you need to know about each of them.

Multi-Base Routers Reviewed and Rated

Now you can purchase a plunge *and* fixed-based router in one kit. We test eight of them to help you buy the best.

More great projects and woodworking techniques

Mission-Style Nightstand

This stylish project matches the bed on *page 40*, as well as a dresser and hope chest in upcoming issues.

Easy-Build Desk Clock

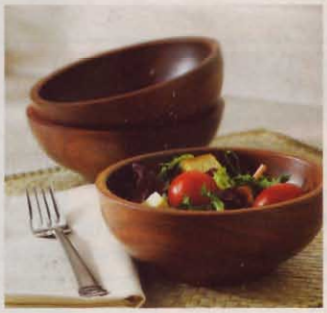
A few scraps of wood and an inexpensive movement are all you need to make this nifty present for someone you love.

Picture-Frame Bookends

Build these in a weekend, and then pair them with your favorite photos.

Child's Lap Desk

This rugged traveling case stores all of the favorite drawing and writing supplies a kid could want.



Turned Salad Bowls

Here's a simple way to turn a whole set in no time. Cut your own blanks or use our economical source.

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